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New Horizons in Subject-Specific Education

RESEARCH ASPECTS OF SUBJECT-SPECIFIC DIDACTICS

University of Maribor

Faculty of Education

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NEW HORIZONS IN SUBJECT-SPECIFIC EDUCATION

RESEARCH ASPECTS OF SUBJECT-SPECIFIC DIDACTICS

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Abstract Over the past three decades, various research methods have been developed in the field of subject-specific educational research. The individual subject didactics have been consolidated enormously, each in its way and at a different pace. The scientific monograph New Horizons in Subject-Specific Education is a study work containing complete and in-depth research of subject-specific didactics, written by several authors from Slovenia, Croatia, Slovakia and the Czech Republic. The monograph presents new ideas and developments in subject didactics, which are of significant importance to those working in the field. It reflects both the diversity of research concerns in this field and the range of methods used to investigate them. The book consists of four thematic parts - STEM Education, Sport and Art Education, Social Science and Humanities Education, and Pedagogy. We hope that the monograph New Horizons in Subject-Specific Education will contribute some new information and knowledge to an evolving but extremely important area of research.

Keywords: quantitative and qualitative methodologies, empirically based research, teaching, learning, knowledge.

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Table of Contents

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Foreword

ALENKA LIPOVEC, JANJA BATIČ, EVA KRANJEC

All school subjects refer to one or more academic fields of study at the research level. The term *subject-specific didactics* refers to this underlying academic field; for example, the didactics of mathematics relates to mathematics. However, the field of subject didactics also draws on findings and results from various educational sciences, which are usually not subject-matter oriented -the didactics of mathematics often relates to psychology as well. Subject didactics generate scientific knowledge itself: this is the case when an academic discipline does not deal with specific areas or issues enough. However, from an academic point of view, subject didactics seem essential for systematic learning. As early as in 1986, Shulman pointed out that mere knowledge of a subject is not enough for teaching. Among other things, he introduced the notion of pedagogical content knowledge (PCK). Shulman defined PCK as a special kind of knowledge that experienced teachers possess, and which constitutes a fusion of subject matter knowledge and the pedagogy suitable for teaching specific topics. It includes knowledge about learners and the presentation of subject matter in a form that makes it understandable to students. According to Shulman, this knowledge distinguishes the subject teacher from the subject specialist.

Over the past three decades, a variety of research methods have been developed in the field of subject-specific educational research. The scientific monograph *New Horizons in Subject-Specific Education* is a study work containing complete and in-depth research of subject-specific didactics, written by several authors from Slovenia, Croatia, Slovakia and the Czech Republic. The monograph presents new ideas and developments which are of significant importance to those working in the field of subject didactics. It reflects both the diversity of research concerns in this field and the range of methods used to investigate them.

The basic framework of the monograph was developed at the conference *The role of subject didactics for the competences of the future* held at the Faculty of Education, University of Maribor, in October 2019. The conference presented findings from practitioners and researchers from a wide range of academic fields interested in researching educational issues and contributing to the scientific discourse. This monograph targets a wide readership -scientists, professors, students, teachers, decision-makers, editors of journals and repositories. As such, it creates area-specific questions. Readers working in the field of education could perhaps think about certain aspects of their research and teaching, such as what kind of teaching models they use in their classrooms, whether these models contribute to the success of students in their discipline area, how they learn about the new trends in education research, and what role they, as teachers educators, play in society.

The book consists of four thematic parts. In the first, STEM Education, there are six chapters: "Research Boxes and Science Process Skills," "Models Describing Secondary-School Students' Opinions and Attitudes Toward Mathematics," "Planned Mathematical Activities in Slovenian Kindergartens," "Completion of Mathematics Homework," "What Do Slovenian and Croatian Teachers Know About Mathematical Modelling?" and "Do Aternative Algorithms for Two-Digit Multiplication Really Help Students to Be More Efficient?" The second part of the book, Sport and Art Education, consists of three chapters: "Testing Motor Predispositions and Competences of Primary School Children in the Czech and Slovak Republics," "Views of Art Education Students on the Inclusion of Artworks in Art Education Lessons," and "Development of Professional Vision in Art Education Video-Interventions." The third part of the book, Social Science and Humanities Education**,** consists of three chapters: "Evaluation of the Practical Pedagogical Training of Students in the Department of Geography at the Faculty of

Arts, University of Maribor," "The Ability to Perceive Initial and Final Sounds in a Word" and "The Novel and the Film *Wonder*." The final, fourth part of the book, Pedagogy, consists of three chapters: "The Use of Textbooks in the Teaching-Learning Process," "Methodological and Thematic Trends: A Case Study of Two Pedagogical Journals in Croatia," and "Use of ICT in the Process of Cooperation with Parents Through Student Perspectives."

On behalf of the Faculty of Education, University of Maribor, we wish to express gratitude to all the participants (authors, reviewers, editors, and others) who contributed to the development of this monograph.

There is an impressive increase in didactic knowledge and subject-related problem awareness. The individual subject didactics have consolidated enormously in recent years, at various speeds, and in their own respective ways. We hope that the monograph *New Horizons in Subject-Specific Education* can and will contribute a bit of knowledge to this evolving but extremely important area of research.

RESEARCH BOXES AND SCIENCE PROCESS SKILLS

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Abstract To develop basic science process skills, a preschool child requires science experiences of sufficient quality and frequency at both home and the kindergarten. The science education first formally offered to such a child significantly improves the development of science process skills like observing, classifying, categorising, comparing, counting, arranging, experimenting, predicting, inferring, formulating assumptions, communicating and researching. The above-mentioned science processes were included in designed picture task cards for 30 research boxes that were prepared to support learning in the natural sciences classes. They were used in kindergartens by 185 children aged mainly 4 to 6. We found that the children were successful in most tasks (at least 82 % of them) and that the majority of the children worked independently on simpler science processes. Although the task-card instructions exclusively contained pictures and symbols, this method of independently conducting activities still demands much from children if a child is encountering it for the first time. Given the children's motivation and performance, we recommend teachers to prepare more research boxes with topical science contents and accompany them with picture task cards in order to ensure the development of children's science process skills and independence.

Keywords: science process skills, research box, picture task cards, preschool children, child's independence.

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Introduction

The development of pre-school children requires a comprehensive approach, as they should develop and master a range of psychomotor, emotional, social and cognitive skills from a variety of areas and contexts. In addition to the development of language, mathematics and art, learning by nature includes the natural and material world. Since learning at this age cannot be based on self-education and chance, there are many good reasons for involving children in organized forms of education. Given the complexity of the social, material and natural world of children in some countries, kindergarten curricula also include elements of technology and nature (Barenthien et al., 2019; Kurikulum za vrtce, 1999), where it is desired that a pre-school child should acquire considerable experience in a natural environment. Since the natural environment is often not accessible to children in a suitable form, it is useful to offer children certain materials that they can experience through free exploration, manipulation and experimentation. However, free play is often too restricted and rarely leads a child on its way to cognitive development. A child must be confronted with challenges in order to explore the offered material successfully and independently. Learning by exploring can become a way for a child to explore nature and the world around it (Krnel, 2001).

Process skills (observing, inferring, classifying, measuring, predicting and communicating) are the fundamental basis of science teaching and learning because they guide scientific inquiries for children. The earlier children have experience with process skills, the better prepared they are for learning science. (Farland-Smith, 2015)

According to Farland-Smith (2015) and Skribe Dimec et al. (2007) the descriptions of *science processes skills* that was used in this research are the following:

Observing -the most essential skill for young children. Children experience the world around them with their senses. Observations can be made by seeing, hearing, smelling, touching and even tasting.

Inferring -a logical thought process that explains the relationships between reason or cause and effect. Children learn to carefully find the relationship between proof and explanation.

Classifying -the inevitable process of organising objects into groups based on observable characteristics. A visible classification system based on observations is an appropriate skill for pre-school children. If the groups are already set, then the process skills are called categorization.

Comparing -young children examine or look for the differences between two or more things, usually by observable characteristics and in a variety of ways appropriate to their stage of development. Descriptions of differences range from obvious differences to details.

Arranging -the process of organising objects into different orders. Children usually recognise the given order or create their own at an early age.

Counting -children say numbers for different subjects one after the other. It is mainly related to measuring.

Measuring -is process of using various measuring tools. Measurements for young learners can be carried out with comparisons between two objects and also with simple, non-standard measuring instruments.

Predicting -small children anticipate what will happen in a certain situation based on their experiences. They learn most when what they think will not happen as a result of scientific investigation. Predicting usually involves the ability to *make assumptions*.

Experimenting -a way of discovering, through questions or practical activities. Children use some simple gadgets to experiment with, such as magnets, cups, spoons, and some kitchen supplies.

Researching -in the context of young children this is mainly done by inquiring the topic, especially to get new information or to reach a new understanding. This includes simple experiments allowing the child more independency.

Communicating -it is important to give a new understanding in different ways, for example by writing words or a sentence, by drawing pictures, by making drawings and diagrams, and by talking about it.

To develop basic science process skills, a preschool child requires natural science experiences of sufficient quality and frequency both at home and in the kindergarten (Gropen et al., 2017; Piasta et al., 2015). The science education first formally offered to such a child significantly improves their development of science process skills and critical thinking, fills them with curiosity, open-mindedness, perseverance and scepticism that lead to progress in the skills of formulating hypotheses and the ability to identify problems. Moreover, it strengthens children's feeling that the world surrounding them is worth exploring, thereby creating a positive attitude to natural science (Kuru & Akman, 2017; Murphy & Smith, 2012). Despite scientific findings in support of the above, preschool teachers are still frequently deciding not to include science activities in kindergartens (Barenthien et al., 2019).

In recent times, as summarised by Jirout and Zimmerman (2015), one can find tendencies in early science education (for children aged 8 and below) that have altered the doctrines that not long ago, according to Piaget's theory of cognitive development, strictly stated that the learning of science process skills should be postponed until adolescence. Science education for small children often focuses on simple natural science processes like observation, description, comparison and discovery. Pre-schoolers are capable of understanding simple experiments aimed at testing hypotheses, recognising a control experiment, explaining simple observed patterns in research and using the results in further decisions or for making generalisations or predictions regarding future examples. A comparative study of research conducted over several years (Jirout & Zimmerman, 2015) reveals that pre-schoolers develop many simple scientific processes or demonstrate early signs of such skills. Nevertheless, many possibilities for development exist, underpinning the need for more research about the introduction of science process skills in kindergartens.

An important requirement of education is the development of a supportive environment that promotes lifelong learning. Early childhood education is a critical time in which experiences are made that enable and encourage children's willingness to engage in lifelong learning (Katz, 2010, as cited in Campbell et al., 2018). STEM at the early childhood level, if properly addressed, could provide educators opportunities to engage young children in activities that make use of their interests, experiences and prior knowledge (Campbell et al., 2018).

On the other hand, research also shows that the time currently spent in STEM early childhood is probably not sufficient to achieve positive educational outcomes (Saçkes et al., 2011)

Learning by exploring can be one of successful STEM practices that can be made even more interesting for a child and can be transformed into an independent task if a learning tool is provided alongside, such as research boxes (Skribe Dimec et al., 2007). A typical research box includes materials from a particular theme, such as interesting everyday items like stones, straws, nuts and bolts, keys and locks. Teachers may use also items that have their "story" like plaster casts of footprints, elements that can be tested, like water solubility, items related to a particular subject, such as certain animal, like birds, natural materials such as foliage, forest fruits, moss and similar.

The exterior of the research box is custom made according to the theme of the material. Inside the box there is a content card showing the contents of the box (Figure 1). Inside the box, in addition to the material, there are several work cards to guide the child as he or she explores. Examples of working cards for different natural science procedures are shown in Figures 2-7.

Figure 1: Content card of 'Screws and Nuts' research box
(from archival material kept by Ungar and Šplajt, 2019)

The use of research boxes in a way sees children 'asking nature' because the task cards feature productive questions that are designed to encourage children to find answers from the material provided and not from books, computers or preschool teachers. Research boxes help children develop a range of science process skills like observing, classifying, measuring, experimenting as well as planning and conducting simple research. Using research boxes boosts children's creativity since an answer to a question can be found in different ways during the research. To ensure children can be successful while independently exploring the research box materials, they must be able to understand the instructions. As pre-schoolers cannot yet read, the instructions should include pictures and symbols or feature realistic photographs of selected objects. This research aimed to establish how successful and independent preschool children are while working with these research boxes.

Methodology

As part of practical sessions for the Didactic Approaches for Natural Environment Teaching subject for preschool education, students prepared (under supervision of the author of this paper) 30 different research boxes containing different materials and picture task cards; these were to guide children in their independent research, making them rely on different science process skills like observing, comparing, counting, classifying, categorising, arranging, experimenting, communicating, inferring, predicting, formulating assumptions and researching. Making measurements was not included. The research boxes contained simple natural materials or materials taken from everyday life, as suggested by Skribe Dimec et al. (2007). The themes included research into materials (e.g. magnetic properties, size of items, spices, kitchen materials), objects (e.g. plastic bottle caps, filled plastic eggs, nuts and screws) and natural materials (e.g. bird feathers, seashells, tree leaves). To get a better idea of the appearance of the research boxes prepared for the kindergarten test, descriptions of two more boxes with titles 'Bird Feathers' and 'Plastic Caps' are given in the appendix.

The tasks required that children use different senses; apart from observing and touching, the tasks included smelling and listening. Tasting was not a component. As this study called for the children to perform their tasks as independently as possible, the instructions containing pictures and symbols were prepared, as shown in Figure 2.

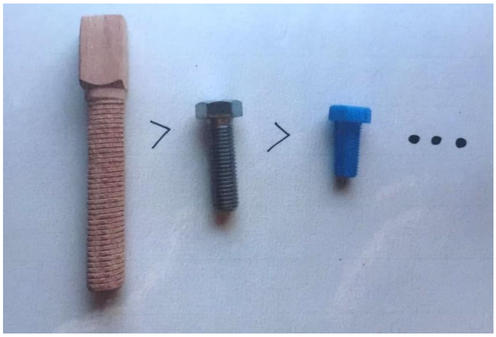

Figure 2: Example of a task card from the 'Screws and Nuts' research box -arranging screws
(from archival material kept by Ungar and Šplajt, 2019)

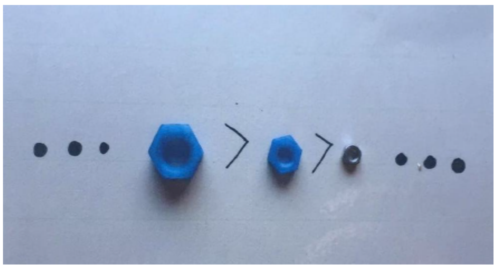

Figure 3: Example of a task card from the 'Screws and Nuts' research box -arranging nuts
(from archival material kept by Ungar and Šplajt, 2019)

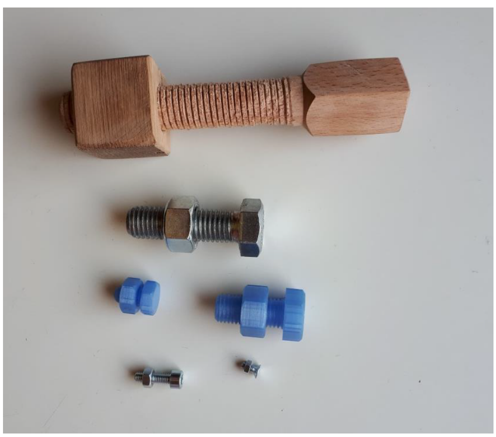

Figure 4: Example of a task card from the 'Screws and Nuts' research box -inferring
(from archival material kept by Ungar and Šplajt, 2019)

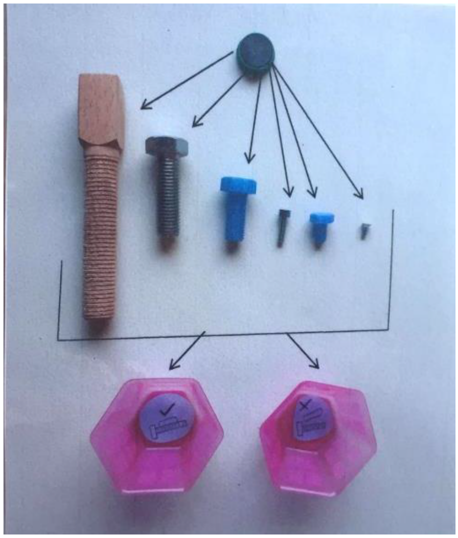

Figure 5: Example of a task card from the 'Screws and Nuts' research box -experimenting with a magnet and categorising objects into magnetic and non-magnetic
(from archival material kept by Ungar and Šplajt, 2019)

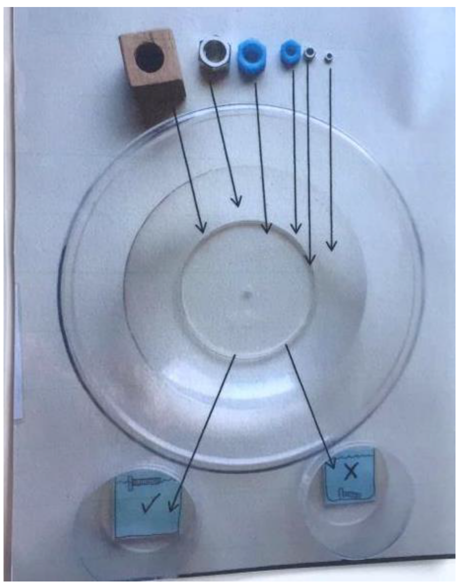

Figure 6: Example of a task card from the 'Screws and Nuts' research box -experimenting with water and categorising objects into those that float and those that sink
(from archival material kept by Ungar and Šplajt, 2019)

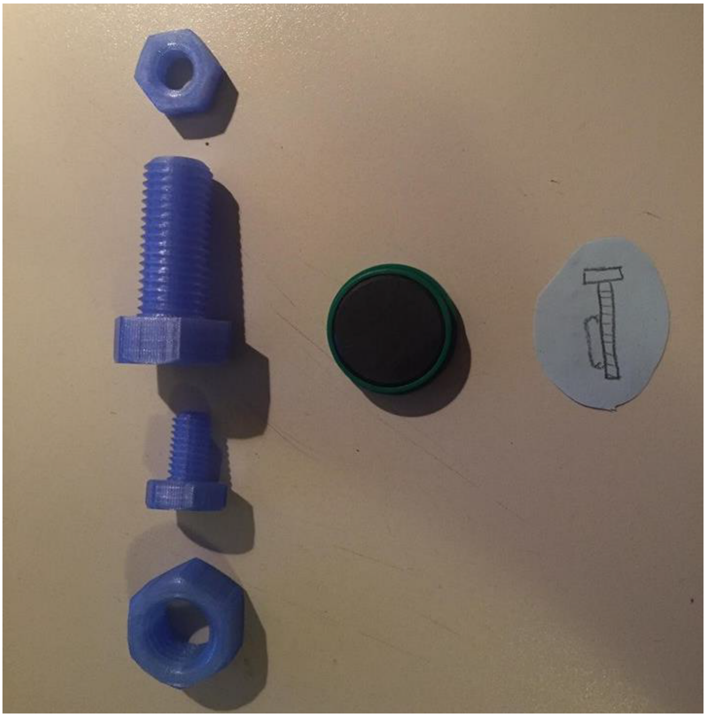

Figure 7: Example of a task card from the 'Screws and Nuts' research box -researching: Are all plastic nuts and screws magnetic?
(from archival material kept by Ungar and Šplajt, 2019)

The research sample consisted of 185 pre-schoolers from different kindergartens across Slovenia, where 160 children were aged from 4 to 6, and the rest were younger. The sample included 94 girls and 91 boys. A selected child was individually observed in their independent work on a research box, lasting up to 20 minutes. Data were gathered from April to June 2019.

The following research questions were formulated:

- Do the children understand the picture-based instructions?
- How independent are the children while working on a research box?
- How successful are the children in carrying out different science processes?

The results were recorded using an observation protocol where we noted down information on a child's age and gender, the science process featured on the task card, and the child's performance. While monitoring the performance, it was considered whether the child was independent and/or needed non-verbal/verbal assistance. Giving direct instructions was avoided as we wanted the child to first think about what the picture-based instruction could mean when confronted by the material found in the research box. Detailed general observations about the child's individual work with the research box were made.

The results were categorised and merged in a table where they were processed with Excel, using basic descriptive statistics. The descriptive results were evaluated in terms of their contents and then compared.

Research Results

After testing and using the prepared research boxes, it was established that not all boxes contained task cards with all science processes. Most boxes, but not all of them, contained at least one task card related to observation, as 163 children performed tasks including observation (Table 1), representing 88 % of all the children in the research. Besides observation, the second and third most frequently used science processes applied to the research boxes were categorising (128 children) and classifying (127 children). More demanding science processes were found on a smaller number of task cards, with the least frequently used processes including communicating (6 children), formulating assumptions (16 children) and researching (38 children). Science processes that were regularly used included comparing, arranging, experimenting, predicting, inferring and counting, as Table 1 shows.

Table 1: Results of the analysis of task-card use from the 30 research boxes along with the performance and independence of 185 children together (not all children participated in all science processes)

Science process	no. of involved children	no. of successful children	% of success	no. of unsuccessful children	% of unsuccessful children	no. of independent children	% of independent children
observing	163	145	89	18	11	56	34
categorising	128	117	91	11	9	43	34
classifying	127	111	87	16	13	44	35
comparing	116	106	91	10	9	43	37
arranging	86	76	88	10	12	40	47
experimenting	84	74	88	10	12	21	25
predicting	68	61	90	7	10	27	40
inferring	55	52	95	3	5	14	25
counting	46	42	91	4	9	16	35
researching	38	31	82	7	18	7	18
formulating assumptions	16	14	87	2	13	6	38
communicating	6	6	100	0	0	3	50

The shares of successful children in Table 1 show that at least 82 % of children involved in a particular science process were successful in the implemented science processes. All children (albeit, only 6) tasked with communication were successful. As many as 95 % of the children were successful in inferring. The biggest share of unsuccessful children (only 18 %) was recorded in relation to the science processes of researching, followed by formulating assumptions (13 %) and classifying (13 %).

The results of this observation of a child's independence (last two columns in Table 1), namely the child did not need any non-verbal/verbal assistance but still successfully did the science process on the task card, show the children were most independent in communicating (50 % of all children completing this process), arranging (47 %) and predicting (40 %), followed by formulating assumptions, comparing, counting, classifying and categorising. Children were the least independent in researching (18 %) as well as in experimenting and inferring (both 25 %).

Regarding the children's understanding of the picture-based instructions on the task cards, it was established, based on observation notes, that children found it difficult to understand certain symbols used like a question mark (?), the less-than and greater-than signs (<, >) and the standard sign for continuation of the sequence (…). Some children had difficulty understanding the instructions for 'observing' or 'taking a look', where an eye was used as a symbol. It was established that some children still have problems recognising the objects in the photographs, as a photograph only shows a two-dimensional view of a selected object. Observation notes revealed the children were highly motivated to participate and showed perseverance in performing the tasks and exploring the prepared materials in the research boxes.

Discussion and Conclusion

The use of simpler science processes, such as observing, comparing, classifying and categorising, gives foundations for pre-schoolers upon which they can build their understanding of the world surrounding them, which is why these processes are included in different planned activities, as established by Jirout and Zimmerman (2015), in many research studies. The fact that most of the task cards in the research boxes (used as a learning tool) featured the above-mentioned simpler science processes confirms the boxes were prepared appropriately. We also established that the children were generally very successful in doing all of the tasks. One trend that is noticeable is that the success rate drops from simpler to more demanding science processes, as researching and formulating assumptions are considered to be less successful processes. Although a smaller share of children was involved in the more demanding science processes, it may be concluded from the results that more demanding science processes, provided they are appropriately prepared, can be included in preschool education as well, and thus give an excellent basis for the development of real scientific research in adulthood.

Since the share of children who performed their tasks completely independently was smaller than of those who successfully implemented the tasks, we can conclude that many children failed to understand the picture-based instructions on the task cards and required non-verbal/verbal assistance. Observation notes reveal a trend of older children being more independent, which is associated with their better understanding of symbolic notations that are learned while completing various tasks in children's magazines or on a computer or smart phone. However, the mentioned assumptions call for more research attention to confirm such correlations. The science processes of researching and experimenting as well as consequent inferring, in the performance of which the children in this research were the least independent, corroborate the findings of some studies (Barenthien et al., 2019; Gropen et al., 2017; Piasta et al., 2015), showing that children lack sufficient experience and opportunities to conduct experiments based on simple research questions and, as expected, become less independent.

The desire to see children work independently on a research box and its natural science contents and materials guided us in the design of the picture task cards featuring symbols. Certain agreed-upon symbols were used, such as a question mark, three dots to denote continuation of the sequence, the mathematical less-than and greater-than signs as well as some symbols arising from pictographs because of the fact that most pre-schoolers cannot read. Children only formally learn about symbols in later years of primary school. Nevertheless, the children still showed considerable misunderstanding of the prepared picture-based instructions. We assume that understanding of picture-based instructions would improve if a child could work on several research boxes containing similar instructions and symbols.

The carefully prepared research boxes with picture and symbol-based instructions are an excellent science tool for developing the science process skills of preschool children aged 4 to 6. The use of research boxes facilitates children's individualisation and differentiation as they become more successful and, when using the research boxes frequently, also more independent. While, as a rule, children are more successful and independent in developing simpler science process skills like observation, categorisation and classification, this study's research findings confirm it is reasonable to also include and develop more demanding science process skills such as experimenting, inferring and researching. By using research boxes in this extremely motivating activity, preschool children are able to build a foundation for themselves for the later development of actual research work methods in adulthood.

Preschool teachers are recommended to upgrade group, frontal and guided science activities in which children learn the basics of specific natural sciences, aids and processes, as well as offer them to children in an individual independent form, i.e. research boxes.

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References

Barenthien, J., Oppermann, E., Steffensky, M., & Anders, Y. (2019). Early science education in preschools – the contribution of professional development and professional exchange in team meetings. *European Early Childhood Education Research Journal, 27*(5), 587–600. https://www.doi.org/10.1080/1350293X.2019.1651937

Campbell, C., Speldewinde, C., Howitt, C., & MacDonald, A. (2018). STEM practice in the early years. *Creative Education, 9*(1), 11–25. https://www.doi.org/10.4236/ce.2018.91002

Farland-Smith, D. (2015). Developing young scientists: Building process skills, questioning skills & the representation of scientists through television viewing and listening (Sid the Science Kid TV Show). *EDUCATION PRACTICE AND INNOVATION, 2*(2), 1–9. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.884.7389&rep=rep1&type=pdf

Gropen, J., Kook, J. F., Hoisington, C., & Clark-Chiarelli, N. (2017). Foundations of science literacy: Efficacy of a preschool professional development program in science on classroom instruction, teachers' pedagogical content knowledge, and children's observations and predictions. *Early Education and Development, 28*(5), 607–631. https://www.doi.org/10.1080/10409289.2017.1279527

Jirout, J., & Zimmerman, C. (2015). Development of science process skills in the early childhood years. In K. Cabe Trundle & M. Saçkes (Eds.), *Research in Early Childhood Science Education* (pp. 143–165). Dordrecht: Springer.

Krnel, D. (2001). Narava. In L. Marjanovič Umek (Ed.), *Otrok v vrtcu. Priročnik k kurikulu za vrtce* [Child in a kindergarten. A handbook to curriculum for kindergartens] (pp. 159–175]. Maribor: Založba Obzorja.

Kuru, N., & Akman, B. (2017). Examining the science process skills of preschoolers with regards to teachers' and children[s]' variables. *TED EĞİTİM VE BİLİM, 42*(190), 269–279. https://www.doi.org/10.15390/EB.2017.6433

Murphy, C., & Smith, G. (2012). The impact of a curriculum course on pre-service primary teachers' science content knowledge and attitudes towards teaching science. *Irish Educational Studies, 31*(1), 77–95. https://www.doi.org/10.1080/03323315.2011.634061

Piasta, S., Logan, J., Pelatti, C., Capps, J., & Petrill, S. (2015). Professional development for early childhood educators: Efforts to improve math and science learning opportunities in early childhood classrooms. *Journal of Educational Psychology, 107*(2), 407–422. https://www.doi.org/10.1037/a0037621

Saçkes, M., Trundle, K. C., Bell, R. L., & O'Connell, A. A. (2011). The influence of early science experience in kindergarten on children's immediate and later science achievement: Evidence from the early childhood longitudinal study. *Journal of Research in Science Teaching, 48*(2), 217–235. https://www.doi.org/10.1002/tea.20395

Skribe Dimec, D., Peklar, A., & Zrnec, J. (2007). *Raziskovalne škatle: učni pripomoček za pouk naravoslovja* [Research boxes: A teaching aid for science lessons]. Ljubljana: Modrijan.

Kurikulum za vrtce [Kindergarten Curriculum]. (1999). Ministrstvo za šolstvo in šport Republike Slovenije. Ljubljana: Zavod za šolstvo https://www.gov.si/assets/ministrstva/MIZS/Dokumenti/Sektor-za-predsolsko-vzgojo/Programi/Kurikulum-za-vrtce.pdf

Appendix 1

Presentation of the research box 'Plastic Caps'

Figure 8: The exterior of the research box 'Plastic Caps'
(from archival material kept by Bezjak and Pirnat, 2019)

Figure 9: Material included in the research box 'Plastic Caps' (caps, cut off bottle necks, ribbons, a box of semolina, blades) and task cards
(from archival material kept by Bezjak and Pirnat, 2019)

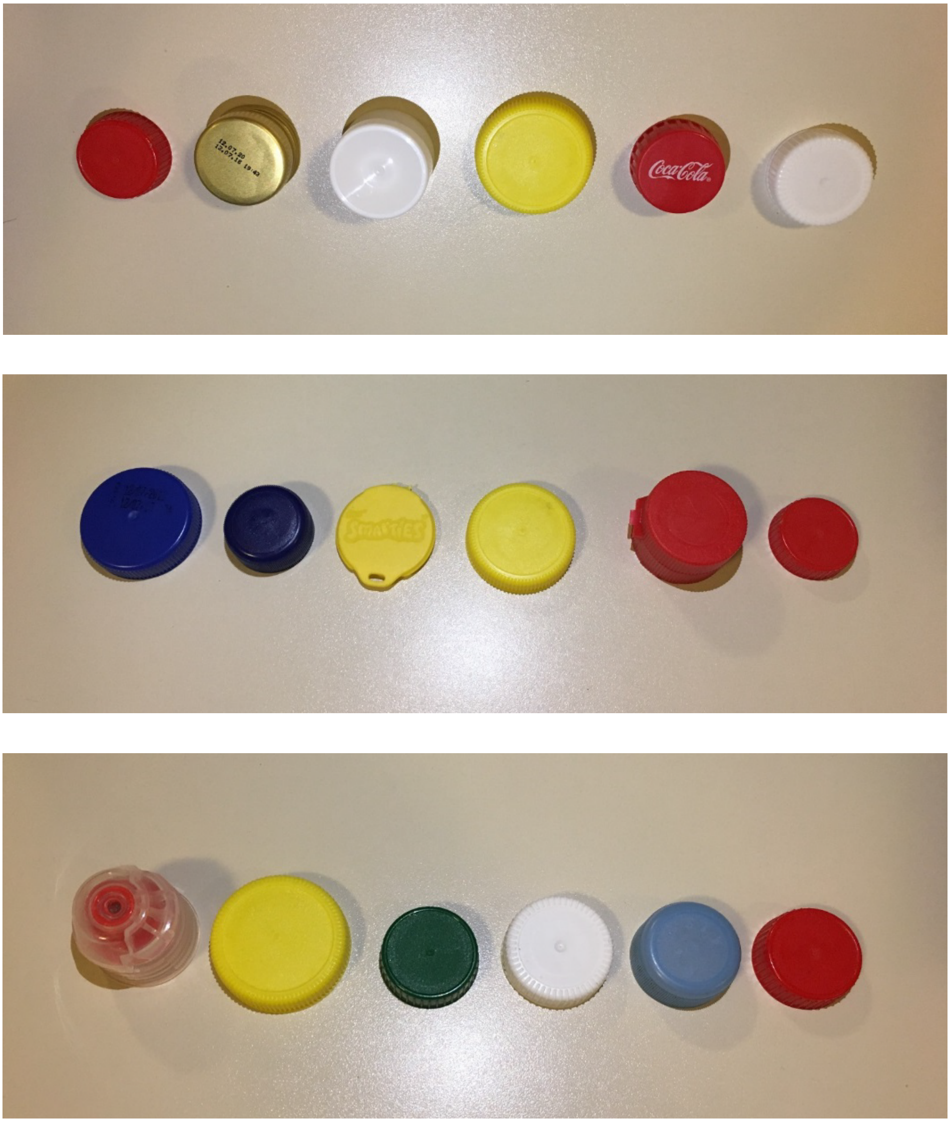

Figure 10: Example of a task card from the 'Plastic Caps' research box -arranging according to the pattern

(from archival material kept by Bezjak and Pirnat, 2019)

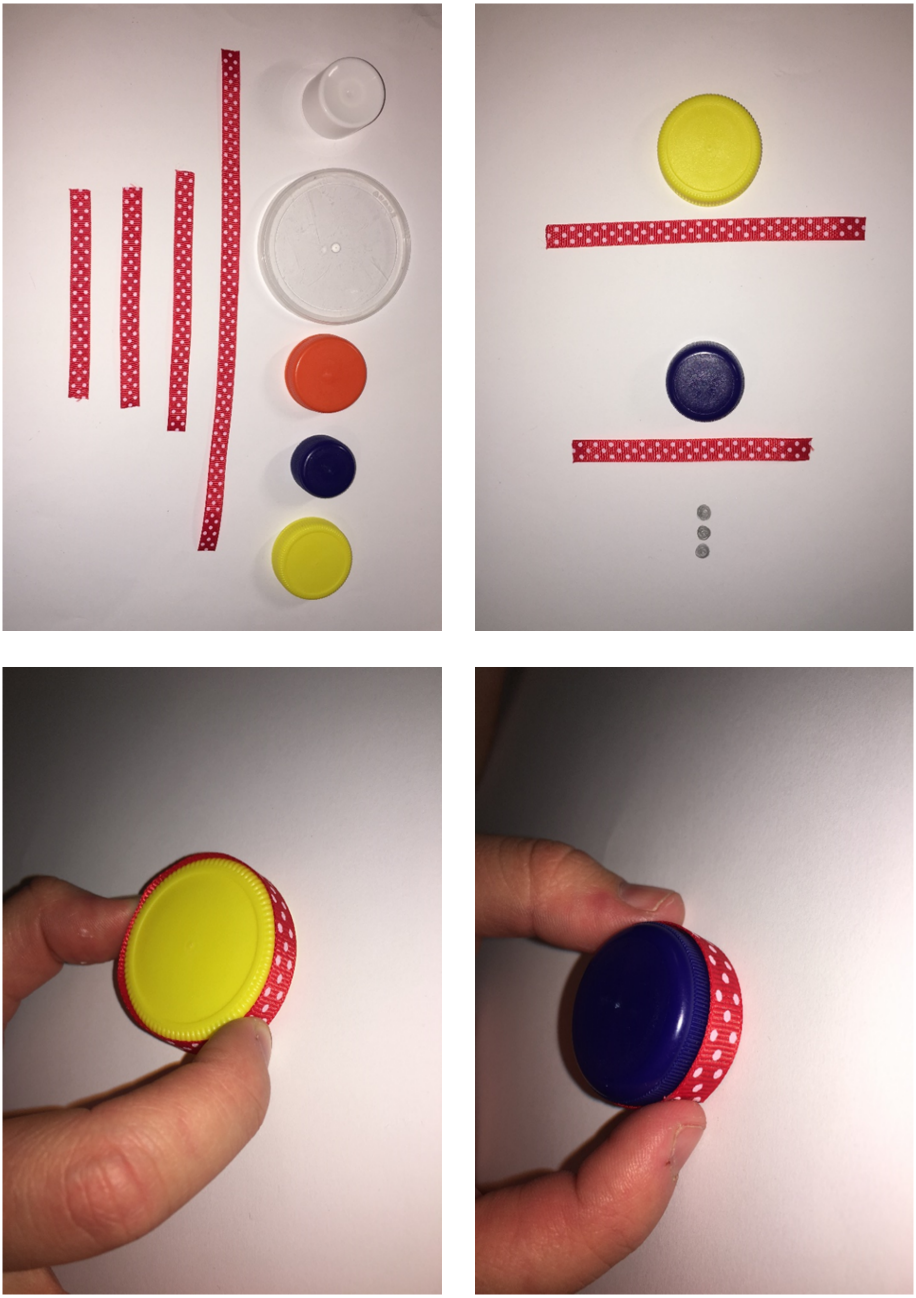

Figure 11: Example of a task card from the 'Plastic Caps' research box -measurement of the circumference of a cap (a multi-step instruction)
(from archival material kept by Bezjak and Pirnat, 2019

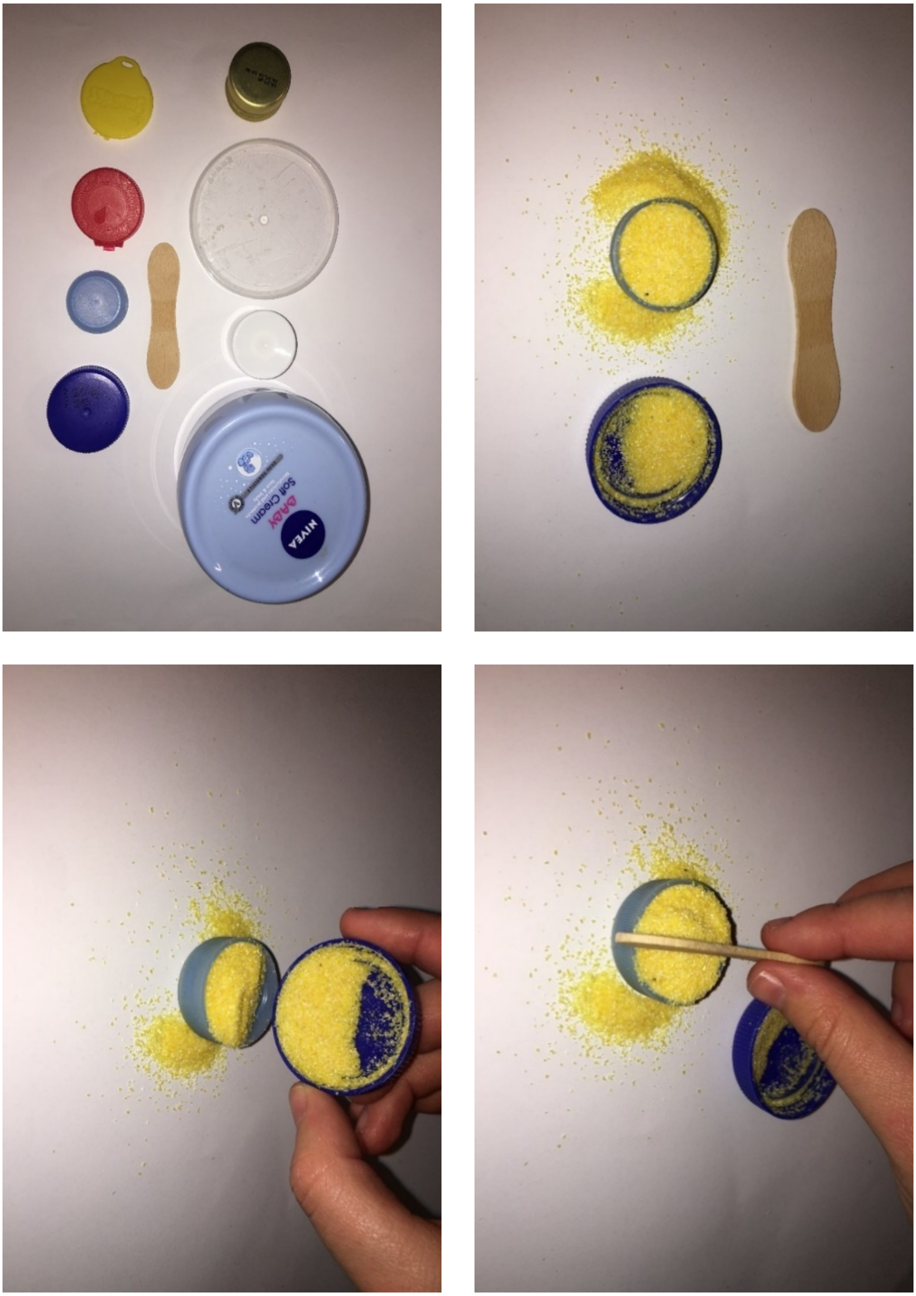

Figure 12: Example of a task card from the 'Plastic Caps' research box -experimenting and comparing the amount of semolina in caps (a multi-step instruction)
(from archival material kept by Bezjak and Pirnat, 2019)

Figure 13: Example of a task card from the 'Plastic Caps' research box -arranging and measuring with a non-standard tool, comparing (a multi-step instruction)
(from archival material kept by Bezjak and Pirnat, 2019)

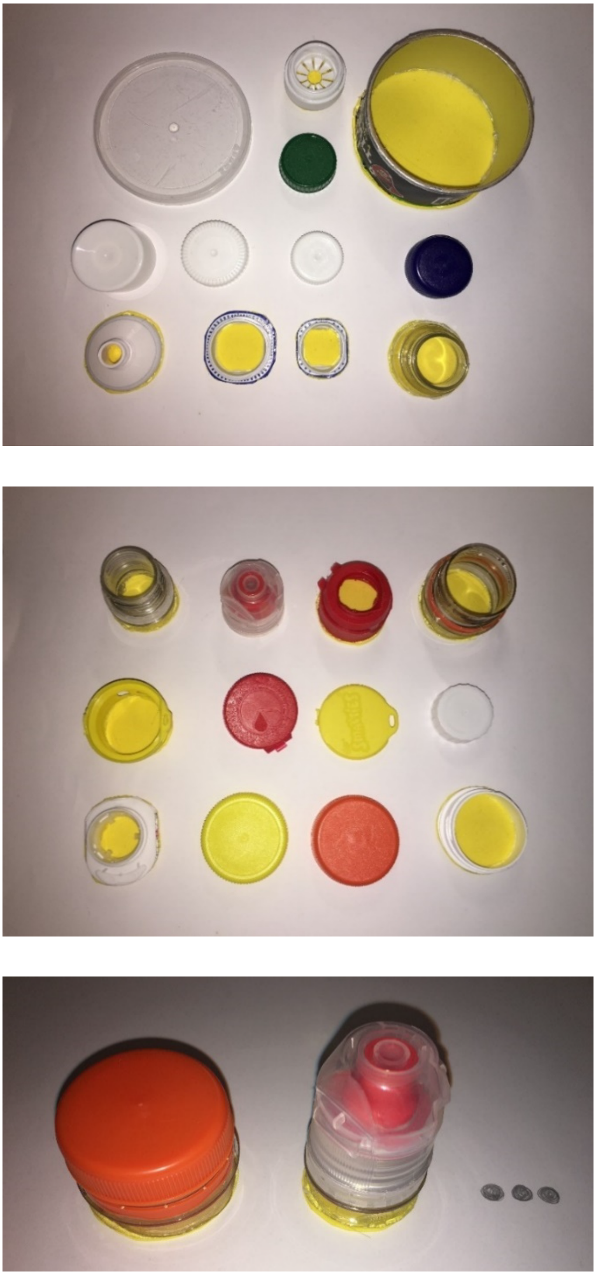

Figure 14: Example of a task card from the 'Plastic Caps' research box - experimenting and inferring caps and bottle necks (a multi-step instruction)
(from archival material kept by Bezjak and Pirnat, 2019)

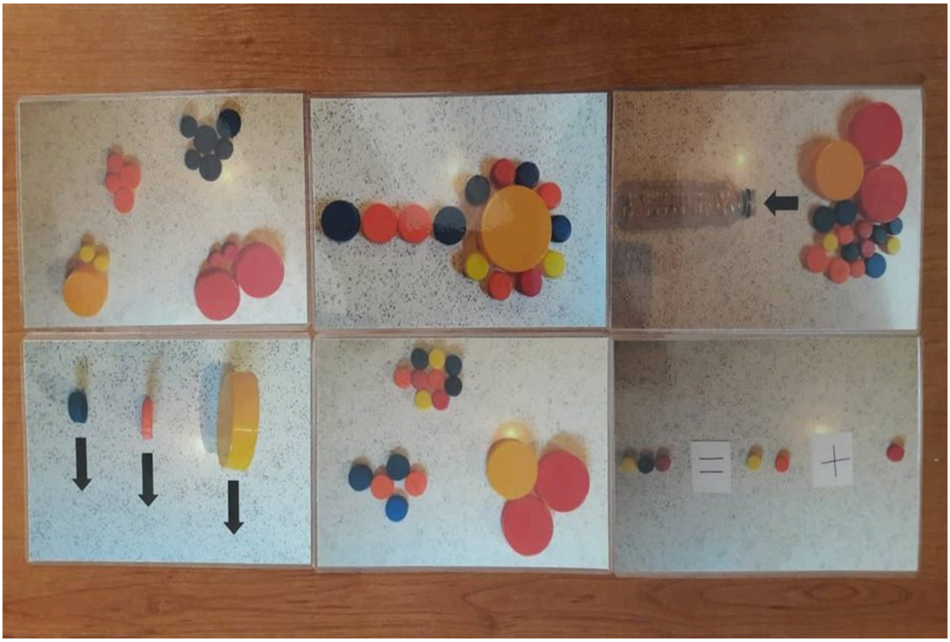

Figure 15: Examples of task cards from the 'Plastic Caps' research box from top to right sorting: classifying by colours, observing, inferring caps and bottle necks, experimenting rolling test, classifying by size, communicating
(from archival material kept by Aberšek and Lepej, 2019)

Appendix 2

Presentation of the research box 'Bird Feathers'

Figure 16: The exterior of the 'Bird Feathers' research box
(from archival material kept by Smiljan, Radolič and Pelcl, 2019)

Figure 17: Material included in the research box 'Bird Feathers'
(from archival material kept by Forjan and Kisilak, 2019)

Figure 18: Content card of the 'Bird Feathers' research box (feathers, magnifier, water pot with dropper, bird photos)
(from archival material kept by Forjan and Kisilak, 2019)

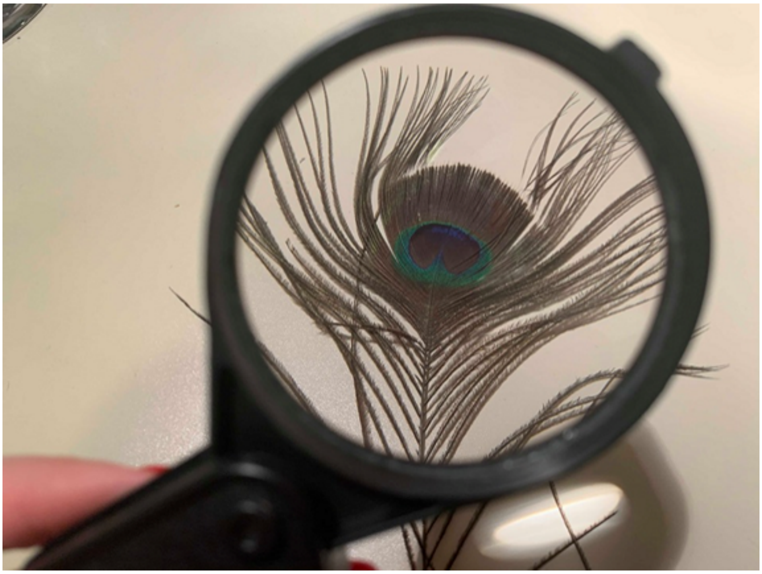

Figure 19: Example of a task card from the 'Bird Feathers' research box -observing the difference in branched structures using magnifier
(from archival material kept by Forjan and Kisilak, 2019)

Figure 20: Example of a task card from the 'Bird Feathers' research box -arranging
(from archival material kept by Forjan and Kisilak, 2019)

Figure 21: Example of a task card from the 'Bird Feathers' research box -inferring which feather belongs to which bird
(from archival material kept by Forjan and Kisilak, 2019)

Figure 22: Example of a task card from the 'Bird Feathers' research box -experimenting: What happens to the dripping water on the feather?
(from archival material kept by Forjan and Kisilak, 2019)

Figure 23: Example of a task card from the 'Bird Feathers' research box -comparing two selected feathers and communicating
(from archival material kept by Forjan and Kisilak, 2019)

Completion of Mathematics Homework

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Abstract Homework is a complex phenomenon, and there are many factors that can influence its effectiveness. This study focused on the completion of mathematics homework. The survey was conducted in Slovenia on a sample of 192 students from the first three grades and 417 students from the last three grades of elementary education. Based on the obtained results, we conclude that the share of completed homework assignments and students' achievements are positively related. Our findings show that students mostly do not complete their homework because they are unable to do it; they do not know how to solve all of the assigned tasks. We believe there are at least two explanations: (a) they do not focus on homework and/or despair over homework before they even start doing it, and (b) they truly do not know how to solve tasks. Since there is a positive link between the time optimisation of doing mathematical homework and the share of completed mathematical tasks (between time optimisation and students' mathematical achievements as well), we believe that improving students' time optimisation of doing mathematical homework (better focus on work) could help with the aforementioned reason for not completing mathematical tasks.

Keywords: mathematics, homework, completion, time optimisation individualized mathematical homework.

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Introduction

Homework is often discussed among the general public, but unfortunately, this phenomenon is frequently a source of conflict between students, parents and teachers. While some think that homework is a necessary fact of life, others state that it is, undoubtedly, an unnecessary waste of time. There are several arguments against assigning homework in schools, such as the following: homework assignments consume too much of the child's free time, reduce the amount of time that children could spend with their families, lead to unhealthy levels of stress for children, to name a few (see Matei & Ciascai, 2015). However, there are some positive views about homework as well; it can refresh, expand and reinforce students' knowledge, it can help teach students responsibility, develop positive study skills and habits. (see Cooper, 1989; Kukk et al., 2015; Matei & Ciascai, 2015; Warton, 2001).

Such inconsistencies can be found not only in these opinions of general public, but also in empirical findings concerning the relationship between homework and students' achievement (Cooper, Robinson, et al., 2006; Fan et al., 2017). One of the possible reasons for the mentioned inconsistency of the results may lie in the diversity of homework characteristics, which can be specific to teachers, parents, students, and others.

From the students' point of view, several studies consider the number of homework assignments completed by students (the share of completed tasks), and it seems that this factor could be positively related to their achievements (Cooper, Lindsay, et al., 1998; Núñez et al., 2015; Núñez et al., 2015a). Therein arises a question of why students do not complete their homework. Namely, if we know that, then we can try to cancel out the mentioned reasons for uncompleted tasks and in this way try to improve students' academic achievements.

Theoretical framework

Homework is an interesting element of education for many authors; it has been studied in many papers (e.g. Cooper, Lindsay, et al., 1998; Cooper, Robinson, et al., 2006; Corno, 1996; Dettmers et al., 2010; de Jong et al., 2000; Dumont et al., 2012; Fan et al., 2017; Ferme & Lipovec, 2019; Fernández-Alonso et al., 2015; Hoover-

Dempsey et al., 2001; Núñez et al., 2015; Núñez et al., 2015a; Podgoršek et al., 2017; Trautwein et al., 2002).

According to Cooper, Robinson, et al. (2006), homework can be defined as tasks assigned to students by school teachers that are meant to be performed during non-school hours. Empirical findings that consider the relationship between homework and students' achievement have been very inconsistent (Cooper, Robinson, et al., 2006; Fan et al., 2017). While several studies suggest a positive relationship between the mentioned two variables (e.g. Fernández-Alonso et al., 2015), there are some studies that do not confirm that relationship or even report the negative correlation between some of the mathematics homework characteristics and students' achievements (de Jong et al., 2000; Trautwein et al., 2002). One of the possible reasons for this inconsistency of the results may lie in the diversity of homework characteristics.

Students themselves clearly play an important role in the effectiveness of homework. Several studies suggest that the number of homework assignments completed by students (the share of completed tasks) and students' achievements are positively related (Cooper, Lindsay, et al., 1998; Ferme & Lipovec, 2019; Núñez et al., 2015; Núñez et al., 2015a;).

For instance, Núñez et al. (2015) conducted a study in Spain, among 454 students aged between 10 and 16 years. Along with others, the researchers posed the following question to the students: "Some students complete all of their homework, and others only complete some of it. And you? How much of your homework do you do ... usually/in a typical week/on a typical weekend?" The students provided their answers using 5-point Likert-type scale ranging from 1 (*I don't do any of my homework*) to 5 (*I do all of my homework*). Based on their answers, the researchers discovered that the amount of homework completed positively and significantly predicts students' academic achievement (measured via students' final academic grades). In addition, Ferme and Lipovec (2019) conducted a study limited to mathematics only. They examined the share of completed mathematical homework and it connected with students' knowledge. Participants of this study were students from the first, second, and third grades of elementary school from Slovenia (N = 192). It was discovered that almost 20 % of students do not complete all (or almost all) tasks from the tasks in assigned homework. Based on the results, they believe that the share of completed tasks and students' self-reported mathematics grades are positively related.

The reasons for homework incompletion were investigated in several papers (see Glazer & Williams, 2001; Hinchey, 1996; Hong et al., 2011; Hudson & Kendall, 2002; Morgenweck, 2006). For example, Hong et al. (2011) found out that students from China (grade 10) most frequently do not complete their mathematical homework, because of its large amount, difficulty and their tardiness/laziness, while Hinchey (1996) mentioned the lack of students' time and their beliefs about the pointlessness of homework. Furthermore, Morgenweck (2006) found out that the most common reasons for students' incompletion of homework assignments include students' forgetting assignments or homework material, lack of students' time, students not understanding the assignments, and their unwillingness and extracurricular activities. According to Hudson and Kendall (2002), other possible reasons for uncompleted assignments include forgetting to complete homework, and anxiety (for instance, worrying about completing it inaccurately). Note that these authors also mentioned unsuitable difficulty of tasks (Hudson & Kendall, 2002). Forgetting homework and not understanding the tasks is mentioned by Glazer and Williams (2001) as well.

One of the possible factors that can positively affect the share of completed tasks by students is better quality of homework time management (time optimisation, focusing on work). Namely, it seems that the mentioned two variables are positively related (Ferme & Lipovec, 2019; Núñez et al., 2015; Núñez et al., 2015a; Xu, 2011). In addition, the quality of time optimisation, expressed as focusing on work while doing homework, is positively related to students' achievement (Ferme & Lipovec, 2019; Núñez et al., 2015; Núñez et al., 2015a;).

Furthermore, since several authors (Hong et al., 2011; Hudson & Kendall, 2002; Morgenweck, 2006) mentioned that students do not complete their homework assignments due to their difficulty (or not understanding of tasks), maybe there is need for more individualized tasks. It seems that teachers do not individualize mathematical homework often (Lipovec & Ferme, 2018). In addition, Murillo and Martínez-Garrido (2013) reported that the individualized homework is positively related to students' achievements.

Research problem

The aim of the study is to examine the rate of completing mathematical homework among students, reveal their reasons for not completing the given tasks, and based on the findings, provide some suggestions for school and home work.

We have set forth the following research questions.

1. What is the share of mathematical homework tasks completed by students?
2. What is the relationship between mathematical homework completion and students' mathematical achievement?
3. Why is mathematical homework not completed?
4. Are students distracted by other factors while doing homework (how students optimize the time while doing mathematical homework)?
5. How frequently do students receive individualized mathematical homework?

Methodology

We have used the methods of quantitative empirical pedagogical research.

The survey, conducted at the end of 2018, was carried out on the basis of completed questionnaires of 609 students from Slovenia. The students were guided by authors when completing the questionnaire. This means that each of the questions posed to the students and/or each of the offered answers was precisely explained to students.

Data obtained from questionnaires was analysed using IBM SPSS Statistics 25. We used the following statistical tests: the chi-squared test, tests for independent samples and Spearman's rank correlation coefficient test.

Sample

The participants of our study were students from Slovenia (N = 609). We have randomly chosen schools from Slovenia and asked them to cooperate in our study. Then, the data were obtained from students of the selected schools who decided to take part in the study.

192 students from the first three grades (first, second, and third grade), and 417 students from the last three grades of elementary education (seventh, eighth, and ninth grade) in Slovenia participated in our study. Note that, in Slovenia, first-graders starting school are 5 years and 8 months to 6 years and 8 months old. The structures of the partial samples are presented in Tables 1 and 2.

Table 1 describes the partial sample of students from the first three grades of elementary education. It presents the share of students from each grade, presents the share of students with respect to the gender and gives the information about students' mathematical knowledge. Students' mathematical knowledge for students from the first three grades of elementary education was measured via their self-assessment grade (of their mathematical knowledge).

Table 1: Sample structure for students from the first, second, and third grade

		f	*f* %
N		192	100.0
Grade	1st	35	18.2
	2nd	63	32.8
	3rd	91	47.4
Gender	Male	80	41.7
	Female	112	58.3
Self-assessment grade	Less than 5*	80	41.7
	5	107	55.7

Table 2 describes the partial sample of students from the last three grades of elementary education. It presents the share of students from each grade, the share of students with respect to the gender and provides the information about students' mathematical knowledge. In this case, the students' mathematical knowledge was measured via students' final grades in mathematics, which were obtained in the previous school year.

Table 2: Sample structure for students from the seventh, eighth, and ninth grade

		f	*f* %
N		417	100,0
Grade	7th	138	33.1
	8th	143	34.3
	9th	136	32.6
Gender	Male	190	45.6
	Female	227	54.4
Final grade in mathematics	1 or 2	81	19.4
	3	118	28.3
	4	116	27.8
	5	101	24.2

Instrument

An anonymous questionnaire comprised questions about students' basic data (class, gender), questions regarding their mathematical knowledge, and questions related to some characteristics of mathematical homework. Students' mathematical knowledge was measured via self-assessment of their mathematical knowledge (for students from the first three grades of elementary education) or via the final mathematics grade in the previous school year as reported by students (from the last three grades of elementary education). Questions about the characteristics of mathematical homework included the share of completed tasks in homework, the reasons for uncompleted tasks, the level of time optimisation and the frequency of individualized tasks.

The following are the questions from the questionnaire (only the ones related to mathematics homework characteristics).

How many tasks do you usually complete from the tasks in the assigned homework?

a) None or almost none.
b) Approximately half of them.
c) All or almost all.

Why don't you complete all of your math homework?

"I do not complete math homework because …" (You can choose more answers.)

a) I have not got enough time (because of other activities);
b) it is too extensive;
c) I cannot do it (I do not know how to do all the tasks);
d) I cannot do it (I do not know how to do all the tasks), even if someone helps me;
e) I forget to complete it;
f) it is not interesting;
g) no one checks if I completed it;
h) I would rather do other things (for instance, spend the time with my friends);
i) I am tired (I have no energy);
j) I do not have the motivation to start doing my homework;
k) other: ____.

Are you, when doing homework for mathematics, distracted by other things (such as cell phones, talking to other people, television)?

Do you think about other things, while doing homework for mathematics?

a) I do not do homework.
b) Other things always distract me. I often think about other things.
c) Other things sometimes distract me. I sometimes think about other things.
d) While doing mathematical homework I think only about the homework. Nothing distracts me.

How often does everyone in your class get the same mathematical homework?

a) Never.
b) Sometimes.
c) Often.
d) Always.

Research results

In the continuation of this paper, we will use the abbreviation MHW – mathematical homework.

The share of completed tasks of MHW

First, we consider the results pertaining to the share of the completed tasks of MHW. As it was mentioned, we posed the following question to the students: "How many tasks do you usually complete from the tasks in the assigned homework?" Students chose one of the three possible answers (None or almost none, Approximately half of them; All or almost all). Tables 3 and 4 present the frequency of students' responses to the question.

The majority of the students from the first three grades, 81,3 %, usually complete all or almost all of MHW. The share of such students from the last three grades is less than 64 %. On the other hand, there is more than 5 % of students from the last three grades of elementary education who complete none or almost none of the assigned homework tasks. Note that the share of such students from the first three grades is less than 2 %.

Table 3: The share of completed tasks of MHW for students from the first, second, and third grade

How many tasks do you usually complete from the tasks in the assigned homework?	*f*	*f* %
None or almost none.	3	1.6
Approximately half of them.	33	17.2
All or almost all.	156	81.3

Table 4: The share of completed tasks of MHW for students from the seventh, eighth, and ninth grade

How many tasks do you usually complete from the tasks in the assigned homework?	*f*	*f* %
None or almost none.	22	5.3
Approximately half of them.	129	30.9
All or almost all.	266	63.8

The share of completed tasks and students' mathematical achievement

In order to reveal the relationship between the share of completed tasks and students' mathematical achievement, we obtained the completion index. It was calculated as an average of the completed tasks, where one represented none or almost none completed tasks and three all or almost all completed tasks. The indexes of final grades in mathematics for students with different self-assessed grades are presented in Tables 5 and 6.

Table 5 shows completion indexes (averages with standard deviations) for students from the first three grades of elementary education. As written, the completion index for all of the mentioned students is 2.80. More precisely, the index is 2.69 for students with a self-assessed grade of 4 or less, and it is 2.90 for students with a self-assessed grade of 5.

Table 5: Completion indexes for students from the first, second and third grade

	1st, 2nd, 3rd – grade
Completion index	2.80 (0.441)
Students with a self-assessed grade of 4 or less	2.69 (0.542)
Students with a self-assessed grade of 5	2.90 (0.305)

Based on the result of the statistical chi-square test, we found out that the two variables, the students' self-assessed grade (5 or at most 4) and the completion index, are related ($p = .004$, $\chi^2 = 10.837$). Moreover, based on the indexes written in the Table 5 and based on the fact that the task completion indexes are statistically different for students with a self-assessed grade of less than 5 and for those with a self-assessed grade of 5 ($p = .002$, $t = 3.112$), we believe that the relationship between the mentioned two variables is positive (in the case of the students from first, second, and third grade).

Table 6: Completion indexes for students from the seventh, eighth, and ninth grade

	7th, 8th, 9th – grade
Completion index	2.59 (0.591)
Students with the final grade 1 or 2	2.21 (0.586)
Students with the final grade 3	2.48 (0.610)
Students with the final grade 4	2.75 (0.491)
Students with the final grade 5	2.82 (0.498)

Table 6 presents completion indexes (averages with standard deviations) for students from the last three grades of elementary education. The completion index for all of the mentioned students is 2.59. In Table 6, completion indexes for students with different final grades are written as well.

Again, based on the result of chi-square test, we found out that the variables students' final grade in mathematics and completion index are related (p = .000, χ^2 = 81.990). In addition, the relationship is positive (p = .000, ϱ = 0.410).

Reasons for the incompletion of mathematical homework

Furthermore, we were interested in students' reasons for not completing MHW. We offered the students a list of reasons and they could choose multiple answers, or add their own reasons.

The list of reasons for the incompletion of mathematical homework is the following.

a) I have not got enough time (because of other activities);
b) it is too extensive;
c) I cannot do it (I do not know how to do all the tasks);
d) I cannot do it (I do not know how to do all the tasks), even if someone help me;
e) I forget to complete it;
f) it is not interesting;
g) no one checks if I completed it;
h) I rather do the other things (for instance, spend the time with my friends);
i) I am tired (I have no energy);
j) I do not have the motivation to start doing my homework;

k) other: ____.

Tables 7 and 8 present the most common reasons for incompletion of mathematical homework as reported by students. The majority of students (from the first three and the last three grades combined) do not complete their homework because they cannot do it, namely, they do not know how to solve the given tasks.

Table 7: Reasons for the incompletion of MHW for students from the first, second, and third grade

Students from the first, second, and third grade	f %
I cannot do it (I do not know how to do all tasks).	21.9
I have not got enough time (because of other activities).	16.7
I forget to complete it.	16.7

Table 8: Reasons for incompletion of MHW for students from the seventh, eighth, and ninth grade

Students from the seventh, eighth, and ninth grade	f %
I cannot do it (I do not know how to do all the tasks).	64.5
I forget to complete it.	36.0
I am tired (I have no energy).	31.2

The time optimisation in doing MHW

Further, we consider students' level of time optimisation while they are doing their MHW (focusing on work while doing MHW). This characteristic of mathematical homework was expressed by students through the answer to the following question: "Are you, when doing homework for mathematics, distracted by other things (such as cell phones, talking to other people, television)? Do you think about other things, while doing homework for mathematics?" We offered the students four possible answers and they could choose one of them.

Table 9 presents the answers of students from the first three grades of elementary education. Only 40.1 % of students from the first three grades completely focus on mathematical homework while doing it, where nothing distracts them (therefore, their level of time optimisation while doing mathematical homework is high). On the other hand, there is almost 10 % of students who reported that they do not focus solely on work while doing mathematical homework. Namely, other things always distract them, and they often think about other things.

Table 9: Time optimisation for students from the first, second, and third grade

Are you, when doing homework for mathematics, distracted by other things (such as cell phones, talking to other people, television)? Do you think about other things, while doing homework for mathematics?	*f*	*f* %
I do not do homework.	1	0.5
Other things always distract me. I often think about other things.	19	9.9
Other things sometimes distract me. I sometimes think about other things.	95	49.5
While doing mathematical homework I think only about the homework. Nothing distracts me.	77	40.1

Next, Table 10 presents the results of the time optimisation while doing mathematical homework for students from the last three grades of elementary education. As seen, only 14.4 % of students from the last three grades reported that they focus completely on mathematical homework while doing it and nothing distracts them. Similar as for the students from the first three grades, there is almost 10 % of students from the last three grades who do not focus solely on work while doing mathematical homework.

Table 10: Time optimisation for students from the seventh, eighth, and ninth grade

Are you, when doing homework for mathematics, distracted by other things (such as cell phones, talking to other people, television)? Do you think about other things, while doing homework for mathematics?	*f*	*f* %
I do not do homework.	20	4.8
Other things always distract me. I often think about other things.	37	8.9
Other things sometimes distract me. I sometimes think about other things.	300	71.9
While doing mathematical homework I think only about the homework. Nothing distracts me.	60	14.4

The time optimisation while doing MHW, the share of completed tasks of MHW and students' mathematical achievement

We found out that the time optimisation (for students who do MHW) and the share of completed tasks are related for students from the first three grades (*p* = .000, $\chi^2{}_{(lr)}$ = 21.176). In this case the correlation is positive (*ρ* = 0.304, *p* = .000). We also calculated the task completion indexes for students with different levels of time optimisation. These indexes are written in Table 11. They indicate the above-written conclusions.

Table 11: Time optimisation and completion of MHW for students from the first, second, and third grade

Time optimisation	Task completion index (1–3)
Other things always distract me. I often think about other things.	2.42
Other things sometimes distract me. I sometimes think about other things.	2.77
While doing mathematical homework I think only about the homework. Nothing distracts me.	2.94

Furthermore, for students from the first three grades of elementary education the variables time optimisation (for students who do MHW) and students' self-assessed grade are related as well (*p* = .008, $\chi^2{}_{(lr)}$ = 9.730).

We calculated the average of the students' self-assessed grades for students with different levels of time optimisation. Their grades are written in Table 12. Furthermore, we found out that the average of the students' self-assessed grade (5 or less than 5) is statistically different for students with different levels of time optimisation (*p* = .007; *F* = 5.05). Based on these findings and the results written in Table 12, we believe that the level of time optimisation is in positive correlation with the students' mathematical achievement (which is, in this case, measured via the students' self-assessment of their mathematical knowledge).

Table 12: Time optimisation and students' mathematical achievement for students from the first, second, and third grade

Time optimisation	Average students' self-assessed grade (1–5)
Other things always distract me. I often think about other things.	3.71
Other things sometimes distract me. I sometimes think about other things.	4.44
While doing mathematical homework I think only about the homework. Nothing distracts me.	4.67

For students from the last three grades of elementary education the results are similar. Namely, the level of time optimisation (for students who do MHW) and the share of completed tasks are related (p = .000, $\chi^2 = 34.468$). The correlation is positive (ϱ = 0.426, p = .000). These findings are supported by the results written in Table 13, which shows the task completion indexes for students with different levels of time optimisation.

Table 13: Time optimisation and completion of MHW for students from the seventh, eighth, and ninth grade

Time optimisation	Task completion index (1–3)
Other things always distract me. I often think about other things.	2.27
Other things sometimes distract me. I sometimes think about other things.	2.66
While doing mathematical homework I think only about the homework. Nothing distracts me.	2.83

Moreover, the statistical chi-squared test shows that the variables time optimisation (for students who do MHW) and students' final grade in mathematics are also related (p = .000, χ^2 = 19.938). Based on the result of the correlation test, we believe that the correlation is positive in this case as well (ϱ = 0.183, p = .001). The findings are supported with the results written in Table 14. We calculated the average of students' final grades in mathematics for students with different levels of time optimisation. Our calculations are presented in Table 14.

Table 14*:* Time optimisation and students' mathematical achievement for students from the seventh, eighth, and ninth grade

Time optimisation	Average students' final grade (1–5)
Other things always distract me. I often think about other things.	3.22
Other things sometimes distract me. I sometimes think about other things.	3.54
While doing mathematical homework I think only about the homework. Nothing distracts me.	4.03

The frequency of individualized mathematical homework

Finally, we considered the frequency of individualized MHW. We posed the following question to the students: "How often does everyone in your class get the same mathematical homework?" Students could choose one of the four possible answers (*always*, *often*, *sometimes*, *never*). Their responses are presented in Table 15 and in Table 16.

Table 15 presents the responses of students from the first three grades of elementary education. As shown, the majority of the students, 87.5 %, from the first, second, or third grade, reported that everyone in their class always or often receives the same mathematical homework.

Table 15: The frequency of individualized MHW for students from the first, second, and third grade

How often does everyone in your class get the same mathematical homework?	*f*	*f* %
Always	119	62.0
Often	49	25.5
Sometimes	23	12.0
Never	1	0.5

Table 16 presents the responses of students from the last three grades of elementary education. Again, the majority of students, 91.6 %, reported that everyone in their class always or often receive the same mathematical homework. Note that in this case the share of such students is higher as in the case of the students from the first three grades of elementary education. Based on these results, we hypothesise that the frequency of individualized MHW is decidedly low.

Table 16: The frequency of individualized MHW for students from the seventh, eighth, and ninth grade

How often does everyone in your class get the same mathematical homework?	*f*	*f* %
Always	263	63.1
Often	119	28.5
Sometimes	28	6.7
Never	7	1.7

Discussion and Conclusion

Several studies suggest that the amount of homework completed by students is positively related to their achievements (Cooper, Lindsay, et al., 1998; Núñez et al., 2015; Núñez et al., 2015a). Our findings are in accordance with these results. Based on the executed statistical tests, we hypothesise that the relationship between the share of the tasks completed by students and their achievements is positive for students from the first, second, and third grade of elementary education. In addition, the students' final grade in mathematics and the completion index are related for students from the last three grades of elementary education (p = .000, χ^2 = 81.990). Based on the results of Spearman's rank correlation coefficient test, we discovered that the mentioned relationship is positive (p = .000, ϱ = 0.410). Furthermore, we found out that more than 18 % of students from the first three grades of elementary education do not complete all or almost all of the tasks in the assigned homework. The share of such students from the last three grades of elementary education is more than 36 %. Based on the mentioned and repeatedly indicated positive relation between the share of completed tasks and students' achievements, we think that there is need (and opportunity) for improvement of these results. One of the ways for that is expanding the knowledge on the reasons for uncompleted tasks as reported by students.

The most common reason for MHW incompletion of students from the first and from the last three grades of elementary education is the following: they do not complete their homework assignment because they cannot do it, namely, they do not know how to solve all tasks. This has already been mentioned by several other authors (Glazer & Williams, 2001; Hong et al., 2011; Hudson & Kendall, 2002; Morgenweck, 2006). There are at least two explanations for these reasons: (a) students do not know how to solve tasks, because they do not really focus on them, and/or they despair over homework before they really start doing it, or (b) they really do not know how to solve tasks.

The first explanation is based on our finding that only 40 % of students from the first three grades and only 14.4 % of students from the last three grades of elementary education focus entirely on doing MHW (they think only about the MHW and nothing distracts them). In addition, we found out that the quality of the students' time optimisation (focusing of work) and the share of completed tasks are positively related ($\varrho = 0.304$, $p = .000$) for students from the first three grades ($\varrho = 0.426$, $p = .000$ for students from the last three grades), which is in accordance with the results of several other studies (Ferme & Lipovec, 2019; Núñez et al., 2015; Núñez et al., 2015a; Xu, 2011). Moreover, our results reveal that the variables time optimisation (for students who do MHW) and students' mathematical achievement are also positively related. Specifically, for students from the last three grades of elementary education, final grades in mathematics are positively related to the levels of time optimisation ($p = .001$, $\varrho = 0.183$). For better understanding of the described situation (for students from the last three grades of elementary education), see Figure 1. It shows the described positive relationships between MHW completion, time optimisation of doing MHW and students' mathematics achievement for students from the last three grades of elementary education. The positive relationships between the mentioned variables exist also for students from the first three grades of elementary education. Based on these findings, we think that better time optimisation of doing MHW (higher level of focusing on work) could help students with the above-mentioned reasons for uncompleted tasks. As written, the other common reasons for uncompleted tasks as reported by students from the first three or from the last three grades of elementary education are the following: students' lack of time for doing homework (due to other activities), forgetting to complete homework, and their lack of energy (tiredness). The role of all of these may be reduced with better time optimisation. Hence, we suggest as it has already been suggested by Núñez et al. (2015): students need to be trained in effective homework time optimisation. In addition, since homework is done at home, maybe parents could help with the improvement of their child's quality of time optimisation (for instance, by providing a quiet room for doing homework, ensuring time for doing homework).

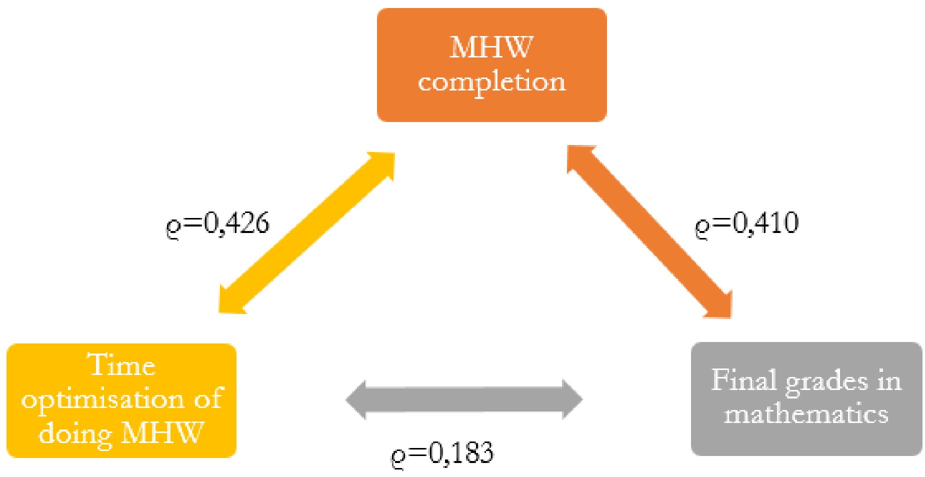

Figure 1: Relationships between MHW completion, time optimisation in doing MHW and students' mathematics achievement for students from the last three grades of elementary education

Situation b) is based on our findings on the frequency of individualized MHW. Namely, more that 87 % of students from the first three grades and more that 91 % of students from the last three grades of elementary education reported that everyone in their class always or often receives the same mathematical homework. Therefore, the share of individualized MHW tasks is low. Recall that Murillo and Martínez-Garrido (2013) reported that the individualized homework is positively related to students' achievements. Hence, we think that there is need for more individualized tasks as well.

Our study reveals that most times students do not complete their homework because they cannot do it (do not know how to). Based on our findings, we conclude that there are at least two different explanations for this: (a) the students do not know how to solve tasks, because they do not really focus on them and/or they despair over homework before they really start doing it and (b) they really do not know how to solve tasks. Based on our results on the positive relationship between time optimisation in doing MHW and the share of completed tasks (and also between time optimisation in doing MHW and students' mathematical achievement), we believe that improving students' time optimisation in doing MHW (a better focus on work) could help with the mentioned reason for uncompleted tasks. Hence, we suggest encouraging students in their efforts towards effective homework time optimisation. On the other hand, since the share of individualized MHW tasks is low and some authors report that the individualized homework is positively related to students' achievements, more individualized homework could help as well.

In conclusion, our study reveals some new findings about the completion of mathematical homework, but due to the complexity of the phenomenon of homework, more in-depth research will be needed. We believe that additional research is needed to cover a wider spectrum of factors which can affect the completion of MHW.

References

Cooper, H. (1989). Synthesis of research on homework. *Educational Leadership*, *47*(3), 85–91.

Cooper, H., Lindsay, J., Nye, B., & Greathouse, S. (1998). Relationships among attitudes about homework, amount of homework assigned and completed, and student achievement. *Journal of Educational Psychology*, *90*(1), 70–83.

Cooper, H., Robinson, J. C., & Patall, E. A. (2006). Does homework improve academic achievement? A synthesis of research, 1987–2003. *Review of Educational Research*, *76*(1), 1–62. https://doi.org/10.3102/00346543076001001

Corno, L. (1996). Homework is a complicated thing. *Educational Researcher, 25*(8*)*, 27–30.

De Jong, R., Westerhof, K. J., & Creemers, B. (2000). Homework and student math achievement in junior high schools. *Educational Research and Evaluation*, *6*(2), 130–157. https://doi.org/10.1076/1380-3611(200006)6:2;1-E;F130

Dettmers, S., Trautwein, U., Lüdtke, O., Kunter, M., & Baumert, J. (2010). Homework works if homework quality is high: using multilevel modeling to predict the development of achievement in mathematics. *Journal of Educational Psychology*, *102*(2), 467–482. https://doi.org/10.1037/a0018453

Dumont, H., Trautwein, U., Lüdtke, O., & Neumann, M., Niggli, A., & Schnyder, I. (2012). Does parental homework involvement mediate the relationship between family background and educational outcomes? *Contemporary Educational Psychology*, 55–69.

Fan, H., Xu, J., Cai, Z., He, J., & Fan, X. (2017). Homework and students' achievement in math and science: A 30-year meta-analysis, 1986-2015. *Educational Research Review*, 20, 35–54. https://doi.org/10.1016/j.edurev.2016.11.003

Ferme, J. & Lipovec, A. (2019). Mathematics homework. In J. Novotná & H. Moraová (Eds.), *International symposium, elementary mathematics teaching: Opportunities in learning and teaching elementary mathematics* (pp. 173–182). Charles University, Faculty of Education, Prague.

Fernández-Alonso, R., Suárez-Álvarez, J., & Muñiz, J. (2015). Adolescents' homework performance in mathematics and science: Personal factors and teaching practices. *Journal of Educational Psychology, 107*(4), 1075–1085. https://doi.org/10.1037/edu0000032

Glazer, N. T., & Williams, S. (2001). Averting the homework crisis. *Educational Leadership*, *58*(7), 43–45.

Hinchey, P. (1996). Why kids say they don't do homework. *The Clearing House*, *69*(4), 242–245.

Hong, E., Wan, M. & Peng, Y. (2011). Discrepancies between students' and teachers' perceptions of homework. *Journal of Advanced Academics*, *22*(2), 280–308. https://doi.org/10.1177/1932202X1102200205

Hoover-Dempsey, K. V., Battiato, A. C., Walker, J. M., Reed, R. P., DeJong, J. M. T., & Jones, K. P. (2001). Parental involvement in homework. *Educational Psychologist*, *36*(3), 195–209. https://doi.org/10.1207/S15326985EP3603_5

Hudson, J. L. & Kendall, P. C. (2002). Showing you can do it: Homework in therapy for children and adolescents with anxiety disorders. *Journal of Clinical Psychology, 58*(5), 525–534. https://doi.org/10.1002/jclp.10030

Kukk, A., Rajalaane, R., Rei, M. L., & Piht, S. (2015). Parents opinions on homework in the II stage of primary school (Estonian example). *Procedia-Social and Behavioral Sciences*, *171*, 134–144. https://doi.org/10.1016/j.sbspro.2015.01.099

Lipovec A. & Ferme J. (2018). Domaća zadaća iz matematike: utjecaj školskog i kućnog okruženja. *Matematika i Škola, 20*(97), 51–63.

Matei, S. & Ciascai, L. (2015). Primary teachers' opinion about homework. *Acta Didactica Napocensia*, *8*(3), 29–36.

Morgenweck, C. K. (2006). *What are elementary students' perceptions of their homework? An investigation on student achievement and their homework completion.* (Publication No. 914) [Doctoral dissertation, Rowan University]. Rowan Digital Works.

Murillo, J. F. & Martínez-Garrido, C. (2013). Homework influence on academic performance. A study of Iberoamerican students of primary education. *Revista de Psicodidáctica*, *18*(1), 157–171. https://doi.org/10.1387/RevPsicodidact.6156

Núñez, J. C., Suárez Fernández, N., Rosário, P., Vallejo, G., Cerezo, R., & Valle, A. (2015). Teachers' feedback on homework, homework-related behaviors, and academic achievement. *The Journal of Educational research, 108*(3), 204–216. https://doi.org/10.1080/00220671.2013.878298

Núñez, J. C., Suárez Fernández, N., Rosário, P., Vallejo, G., Valle, A., & Epstein, J. L. (2015a). Relationships between perceived parental involvement in homework, student homework behaviours, and academic achievement: differences among elementary, junior high, and high school students. *Metacognition and Learning, 10*(3), 375–406. https://doi.org/10.1007/s11409-015-9135-5

Podgoršek M., Lipovec A., & Ferme. J. (2017). Vpliv nekaterih situacijskih in motivacijskih dejavnikov na dosežke četrtošolcev pri matematiki v raziskavi TIMSS 2015. *Šolsko polje*, 28 (5/6), 31–53.

Trautwein, U., Köller, O., Schmitz, B., & Baumert, J. (2002). Do homework assignments enhance achievement? A multilevel analysis in 7th-grade mathematics. *Contemporary Educational Psychology*, *27*(1), 26–50. https://doi.org/10.1006/ceps.2001.1084

Warton, P. M. (2001). The forgotten voices in homework: Views of students. *Educational Psychologist, 36*(3), 155–165. https://doi.org/10.1207/S15326985EP3603_2

Xu, J. (2011). Homework completion at the secondary school level: A multilevel analysis. *The Journal of Educational Research*, *104*(3), 171–182. https://doi.org/10.1080/00220671003636752

The Ability to Perceive Initial and Final Sounds in a Word

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Abstract Teachers test the students' ability to perceive initial and final sounds at the beginning of the first grade. They use the findings to create differentiation and individualization in promoting phonological awareness, as individual levels of phonological awareness develops in a specific set. This development does not proceed as quickly with all pupils. They first perceive syllables in words, then the initial sound, followed by the final sound, and, lastly, they develop the ability to divide words into sounds. It is important that teachers carefully plan exercises for the development of phonological awareness, since the reading and writing success depend on successful development of phonological awareness abilities. The focus of this research was on possible differences in the ability to perceive phonological awareness among first grade students led. The study involved two comparable groups of pupils, with a large difference in the ability to perceive initial and final sounds. The results show that the ability to perceive final sounds is approximately equal in both groups, compared to the perception of initial sounds.

Keywords: initial sound, final sound, first grade, gender, literacy.

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Introduction

Systematic literacy in the first grade is influenced by many factors. These include the perceptual abilities that pupils already develop in their preschool years. This period represents the most intense development of perceived abilities. One of the most important perceived abilities is auditory perception, which includes auditory discernment and auditory parsing. Levels of phonological awareness evolve from less demanding to more demanding in the following order: rhymes, sentence divisions, split/merge of syllables, split/merge of beginnings and endings (including initial and final sounds), and split/merge of individual sounds (Chard & Dickson, 1999).

Research has shown the beneficial impact of promoting phonological awareness in preschool years on the development of the aforementioned ability (Ball & Blachman, 1991; McGee & Ukrainetz, 2009; Rohl, 2000; Strickland, 2011; Venn & Jahn, 2004). The perception of phonological awareness is significantly influenced by frequent exercises which should be diverse and interesting. Teachers should encourage pupils' phonological perceptions before literacy and during systematic literacy, as this is beneficial for pupils. It should be emphasized that pupils need a lot of exercise and training experience in perceiving phonological awareness (Ball & Blachman, 1991; Rohl, 2000; Ropič, 2014, 2016, 2017; Strickland, 2011).

At the beginning of the first grade, teachers accelerate the perception of the initial sound in a word and slightly later, the final sound in a word. Pupils who correctly perceive the initial and the final sound in a word are spelling the words. In regard to perceiving initial and final sounds in a word, some research considers that students are most successful when that sound is a consonant (Ashby et al., 2013). There is no similar research in Slovenia.

It cannot be ignored that some research links the success of perceiving initial and final sounds with word length. Pupils are supposed to be more successful in non-syllabic or monosyllabic words. The difficulty in perceiving the initial and final sounds is enhanced by the choice of longer or multi-syllabic words (Levin, 2007).

The research does not correlate the ability to perceive initial and final sounds in a word with gender. In some screening cases, girls are more successful, in others, boys -sometimes, they even achieve the same averages. Research findings pointed out that differences between boys and girls in their ability to perceive initial sounds in a word and on other levels of phonological awareness were statistically insignificant (Bider Petelin, 2014; Božič et al., 2007).

Method

As research has shown various influences on the development of phonological awareness of children in kindergarten and differently developed phonological awareness of students entering the first grade, I decided to carry out a study examining the ability to perceive the initial and final sounds in words of first grade pupils. 192 pupils were examined individually and divided into two basic groups. The first group included 98 pupils and was named "G1". Typical for this group is that before entering elementary school, these pupils had fewer exercises of phonological awareness and came from a less stimulating environment. The second group contained of 94 pupils and was named "G2". These mostly came from a stimulating environment and from kindergartens where phonological awareness was present.

The research also focused on whether there was a difference between pupils according to gender (boys, girls) in their ability to perceive initial and final sounds.

The study covers two levels of phonological awareness; the first level examines the perception of the initial sound in a word and the second the perception of the final sound in a word. Each set contained sixteen frames. Each pupil named a single frame and named the initial sound of that frame. In the second set, pupils first observed all the frames to get the naming without the diminutives, as that would change the final sound in the word. Pupils then named the final sound in the word of each frame.

In the study, a descriptive and causal non-experimental method of empirical research was used. The obtained data were processed with the SPSS program. To analyze the differences between the groups, a t-test was used to get independent samples in the total number of correctly perceived initial and final sounds in words. The x^2-test was used because I was interested in the differences between pupils -whether there was a connection, and what the frequencies were in the ability to perceive initial and final sounds at the level of a single word.

To analyze differences between students according to gender (boys, girls) in the perception of initial and final sounds in a word, a t-test for independent samples was used. I was also interested in the differences that occurred between pupils in terms of gender at the level of the chosen sixteen cases in the perception of the initial sound in a word and sixteen cases in the perception of the final sound in a word. For the purpose of the latter, the x^2-test was used.

Results

Table 1: Results of the t-test among pupils of groups G1 and G2 in ability to perceive initial sounds.

Group	*N*	$\bar{x}$	*s*	*F*	*p*	*t*	*p*
G 1	98	11.39	4.873	9.134	.000	-3.552	.000
G 2	94	13.60	3.620				

Table 1 shows the differences between the two groups at the beginning of first grade in pupils' ability to perceive the initial sound in a word. The difference is statistically significant (p = .000). Pupils of the G2 group perceived on average 13.60 initial sounds per word out of the 16 possible and were therefore more successful than their peers in G1 who perceived an average of 11.39 initial sounds in a word out of the 16 possible. The standard deviation indicated a greater range in the ability to perceive initial sounds among pupils in G1, which means that in this group a greater number of pupils was unable to perceive initial sounds and that there were large differences in the aforementioned ability. Results show that pupils' previous knowledge in the perception of initial sounds in G2 is higher, as they have been earlier and more frequently stimulated in promoting phonological awareness.

Comparing research in the ability of perceiving initial sounds in a word of first grade pupils with that of children in the preschool period just before first grade (June) shows that there is no statistically significant difference in the ability to perceive initial sounds among preschool children, but there is a tendency in the difference in favor of those children whose perception of initial sounds was stimulated early, in kindergarten; these children were exposed to phonological awareness exercises for a longer time (Ropič, 2017). The positive impact of systematic exercises to promote the perception of the initial sound is also emphasized by other authors (Mesmer & Griffith, 2005; Ropič, 2016; Strickland, 2011).

Promoting phonological awareness during preschool and in early years of primary school has an impact on successful development of phonological awareness (Ball & Blachman, 1991; Cardoso-Martins et al., 2010).

Table 2: Results of the t-test among pupils of groups G1 and G2 in ability to perceive final sounds.

Group	N	$\bar{x}$	s	F	p	t	p
G 1	98	7.07	5.449	0.000	.987	-2.464	.015
G 2	94	9.03	5.572				

Upon comparing the obtained results with the results of similar research of preschool children just before attending the first grade, the findings highlight that both studies show a statistically significant difference between the two groups. More successful were those who were more stimulated to promote phonological awareness or have previously started performing exercises to develop phonological awareness, which is highlighted in the following research as well (Graaff et al., 2007).

The ability to perceive final sounds in a word, compared to perceiving initial sounds in a word, presents a more challenging activity or level of phonological awareness. A child develops those levels gradually and slowly, requiring the educator/teacher to properly plan work and integrate differentiation through individualization.

Table 3. Results of the x^2-test between the two groups of children in the perception of the initial sound.

Initial sound	No. of child	Group 1 Points		Group 2 Points		Total		Result of x^2-test
		0	1	0	1	0	1	x^2 p
i	*f*	28	70	16	78	44	148	$x^2 = 3.623$ $p = .057$
	f %	28.6	71.4	17.0	83.0	22.9	77.1	
m	*f*	25	73	5	89	30	162	$x^2 = 14.837$ $p = .000$
	f %	25.5	74.5	5.3	94.7	15.6	84.4	
j	*f*	45	53	26	68	71	121	$x^2 = 6.864$ $p = .009$
	f %	45.9	54.1	27.3	72.3	37.0	63.0	
e	*f*	31	67	14	80	45	147	$x^2 = 7.492$ $p = .006$
	f %	31.6	68.4	14.9	85.1	23.4	76.6	
v	*f*	31	67	17	77	48	144	$x^2 = 4.696$ $p = .030$
	f %	31.6	68.4	18.1	81.9	25.0	75.0	
k	*f*	21	77	13	81	34	158	$x^2 = 1.901$ $p = .168$
	f %	21.4	78.6	13.8	86.2	17.7	82.3	
u	*f*	17	81	12	82	29	163	$x^2 = 0.785$ $p = .376$
	f %	17.3	82.7	12.8	87.2	15.1	84.9	
d	*f*	23	75	9	85	32	160	$x^2 = 6.670$ $p = .010$
	f %	23.5	76.5	9.6	90.4	16.7	83.3	
c	*f*	29	69	16	78	45	147	$x^2 = 4.225$ $p = .040$
	f %	29.6	70.4	17.0	83.0	23.4	76.6	
r	*f*	22	76	7	87	29	163	$x^2 = 8.421$ $p = .004$
	f %	22.4	77.6	7.4	92.6	15.1	84.9	
š	*f*	34	64	15	79	49	143	$x^2 = 8.861$ $p = .003$
	f %	34.7	65.3	16.0	84.0	25.5	74.5	
p	*f*	21	77	4	90	25	167	$x^2 = 12.494$ $p = .000$
	f %	21.4	78.6	4.3	95.7	13.0	87.0	
h	*f*	29	69	9	85	38	154	$x^2 = 12.111$ $p = .001$
	f %	29.6	70.4	9.6	90.4	19.8	80.2	
g	*f*	28	70	17	77	45	147	$x^2 = 2.940$ $p = .086$
	f %	28.6	71.4	18.1	81.9	23.4	76.6	
ž	*f*	18	80	11	83	29	163	$x^2 = 1.662$ $p = .197$
	f %	18.4	81.6	11.7	88.3	15.1	84.9	
f	*f*	47	51	24	69	71	120	$x^2 = 9.343$ $p = .002$
	f %	48.0	52	25.8	74.2	37.2	62.8	

Table 3 shows a statistically significant difference ($p = .000$) in the ability to perceive initial sounds in a word with an initial sound "m" and an initial sound "p". In G1, a quarter of pupils did not perceive the initial sound "m", while in G2, they perceived that initial sound in 94.7 %. The initial sound "p" also caused problems for pupils in G1 in 21.4 %, while in G1 only 4.3 % of pupils did not perceive it. A statistically significant difference between the groups shows in the perception of the initial sound "h". Almost 30 % of pupils in G1 did not detect the initial voice "h", and only 9.6 % had difficulty perceiving it, including the pupils of G2. A significant difference (p = .002) between the groups also occurred when the initial sound "f" is perceived. In G1 only 52 % perceived this sound, and 74.2 % in G2. A statistically significant difference (p = .003) in the ability to perceive the initial sound "š" should be noted as well -in G2 84 % and in G1 only 65.3 %. Table 3 shows a statistically significant difference in the perception of initial sounds "r" (p = .004), "e" (p = .006), "j" (p = .009), "d" (p = .010), "v" (p = .30) and "c" (p = .040). In G2 pupils showed a greater ability to perceive the aforementioned initial sounds.

The tendency indicates a higher performance in G2 in the perception of the initial sound "i", which was successfully perceived in 83 %, and in the perception of the initial sound "g", which was correctly perceived in 81.9 %.

There are no statistically significant differences in other tests of initial sounds between G1 and G2. The differences were smaller in the perception of the initial sound "k", even smaller in "ž" and the smallest in "u".

Some authors have found that initial sounds that are consonants enable children to perceive sounds more successfully (Ashby et al., 2013). In this study, that prediction is only partially realized within G2. Pupils in this group successfully perceived the initial sound of six words, where the initial sound is a consonant (p, m, r, d, h, ž). In the following initial sounds, words beginning with the vowel (u), consonant (k), vowel (e), consonant (š) and vowel (i) ware perceived. The final third of the performance in G2 includes words beginning with the initial sound of consonants (e, g, v, f, j). Pupils in G1 who were less successful in perceiving initial sounds than pupils in G2 (p = .000) most successfully perceived the initial "u" and had been successful in perceiving initial sounds in the words that begin with the initial consonant only in the next six places of successful perception (ž, p, k, r, d, m). These results correlate with the findings of other studies (Levin, 2007), as the pupils of both groups were more successful in perceiving initial sounds in shorter or easier words. There is no similar research in the Slovenian language.

Table 4. Results of the x2-test between the two groups of children in the perception of the final sound.

Final sound	No. of child	Group 1 Points		Group 2 Points		Total		Result of x^2-test
		0	1	0	1	0	1	x^2 p
a	*f*	52	46	45	49	97	95	$x^2 = 0.517$ $p = .472$
	f %	53.1	46.9	47.9	52.1	50.5	49.5	
š	*f*	53	45	39	55	92	100	$x^2 = 3.048$ $p = .081$
	f %	54.1	45.9	41.5	58.5	47.9	52.1	
e	*f*	77	21	65	29	142	50	$x^2 = 2.212$ $p = .137$
	f %	78.6	21.4	69.1	30.9	74.0	26.0	
a	*f*	54	44	41	53	95	97	$x^2 = 2.532$ $p = .112$
	f %	55.1	44.9	43.6	56.4	49.5	50.5	
a	*f*	52	46	44	50	96	96	$x^2 = 0.750$ $p = .386$
	f %	53.1	46.9	46.8	53.2	50.0	50.0	
š	*f*	55	43	39	55	94	98	$x^2 = 4.111$ $p = .043$
	f %	56.1	43.9	41.5	58.5	49.0	51.0	
a	*f*	50	48	29	65	79	113	$x^2 = 8.060$ $p = .005$
	f %	51.0	49.0	30.9	69.1	41.1	58.9	
o	*f*	57	41	41	53	98	94	$x^2 = 4.063$ $p = .044$
	f %	58.2	41.8	43.6	56.4	51.0	49.0	
a	*f*	45	53	37	57	82	110	$x^2 = 0.843$ $p = .359$
	f %	45.9	54.1	39.4	60.6	42.7	57.3	
a	*f*	41	57	33	61	74	118	$x^2 = 0.918$ $p = .338$
	f %	41.8	58.2	35.1	64.9	38.5	61.5	
e	*f*	64	34	47	47	111	81	$x^2 = 4.609$ $p = .032$
	f %	65.3	34.7	50.0	50.0	57.8	42.2	
o	*f*	45	53	37	57	82	110	$x^2 = 0.843$ $p = .359$
	f %	45.9	54.1	39.4	60.6	42.7	57.3	
a	*f*	43.	55	33	61	76	116	$x^2 = 1.543$ $p = .214$
	f %	43.9	56.1	35.1	64.9	39.6	60.4	
b	*f*	81	17	61	33	142	50	$x^2 = 7.857$ $p = .005$
	f %	82.7	17.3	64.9	35.1	74.0	26.0	
a	*f*	44	54	32	62	76	116	$x^2 = 2.364$ $p = .124$
	f %	44.9	55.1	34.0	66.0	39.6	60.4	
a	*f*	60	38	49	45	109	83	$x^2 = 1.618$ $p = .203$
	f %	61.2	38.8	52.1	47.9	56.8	43.2	

Table 4 shows the performance of first grade pupils in the perception of final sounds. The biggest difference -also a statistically significant difference (p = .005) between groups in the perception of final sounds -was reflected in the perception of "b" and "a". The results show that 82.7 % of pupils in G1 were unsuccessful in the perception of the final sound "b". Their peers in G2 were unsuccessful in 64.9 %. The difficulty in perceiving the final sound "b" might have increased because it appeared in the consonant cluster "mb". The results point to a heavier perception of final sounds when they are part of a consonant cluster. In the second case of large group differences, the perception of the final sound "a" emerged from the syllable "ra". In this case, 51 % of pupils in G1 and 30.9 % in G2 were unsuccessful.

There is also a statistically significant difference between the groups (p = .032) in the perception of the final sound "e" when that sound appeared in the syllable "je". In G2, the final sound "e" was correctly recognized by half the pupils, and only 34.7 % in G1. There is a statistically significant difference between the groups in the perception of the final sound "š" (p = .043) and "o" (p = .044). In both cases, the pupils of G2 were more successful in perceiving the final sound, as they have correctly perceived "š", which was in the syllable "oš".

Furthermore, these pupils were more successful in perceiving the final sound "o" which, in this case, appeared in the syllable "vo".

In one case, there was a tendency to perceive the final sound "š" which was in the syllable "iš". In this particular case, pupils of G2 were more successful.

In all the other cases of the perception of final sounds, there are no statistically significant differences between the groups. The results show the following sequence in the differences between the groups: "a" (na), "a" (iba), "e" (ce), "a" (ca), "a" (ša), "a" (aba), "a" (ta), "o" (ro), "a" (ja) and "a" (la). The results of the syllable "la" came closest to the ability to perceive the final sound "a". The peculiarity of this word is that it begins with a vowel, followed by a consonant, another consonant and ends with a vowel. This word contains two syllables (vowel and consonant, consonant and vowel).

When looking at the ability to perceive final sounds from another point of view, it should be noted that the pupils in G2 were most successful in perceiving the final sound "a" when it appeared in the syllable "ra". Their peers were only sixth in determining final sounds in this word. The pupils of G1 were most successful in perceiving "a" in the word that appeared in the "iba" sequence. In this case of successful determination of the final sound, the pupils of G2 came in third place.

According to some authors (Ashby et al., 2013), consonants as initial or final sounds in a word make perception easier. The results of this study do not fully confirm this. This research indicates difficulties in detecting final sounds in longer words with two-syllable consonant clusters and three-syllable words (Levin, 2007).

Table 5: The results of the t-test among pupils in the perception of initial sounds according to gender

Gender	*N*	$\bar{x}$	*s*	*F*	*p*	*t*	*p*
Boys	100	12,33	4,780	4,035	,046	-0,623	,534
Girls	92	12,73	4,000				

Table 5 shows the results of the t-test -the difference between pupils according to gender in the perception of initial sounds in a word is not statistically significant. The arithmetic mean shows that girls were slightly more successful in perceiving the initial sound. Also, the standard deviation indicates large differences between them. Boys perceived an average of 0.4 less of initial sounds per word than girls. The standard deviation indicates even greater individual differences among boys compared to girls. Some pupils among boys and girls have been given different amounts of exercises to promote phonological awareness.

Comparing this research with a study (Bider Petelin, 2014) conducted with students of the same age in different stages of reading and writing basics which presents children's prior knowledge of systematic literacy in first grade, both studies refute the importance of gender in the abilities of phonological awareness. No similar research was found on an international scale; therefore, no comparison is possible.

Table 6: The results of t-test among pupils according to gender in the ability to perceive final sounds

Gender	*N*	$\bar{x}$	*s*	*F*	*p*	*t*	*p*
Boys	100	8,17	5,920	5,918	,016	0,345	,730
Girls	92	7,89	5,207				

The results in Table 6 show that all pupils, boys and girls, had significantly more difficulties in perceiving final sounds in a word than in perceiving initial sounds in a word. Furthermore, the differences in the perception of final sounds in a word between boys and girls are not statistically significant. Out of sixteen points, they reached around eight points. On the level of phonological awareness, namely the perception of the final sounds in a word, boys are slightly better (the arithmetic mean is 8.17) compared to girls (the arithmetic mean is 7.89). The standard deviation indicates large individual differences among boys and girls. There are slightly greater differences among boys in the perception of final sounds in a word compared to girls.

Table 7: The results of the χ^2-test according to gender in the perception of the initial sound

Initial sound in a word	No. of child	Boys		Girls		Total		Result of χ^2- test	
		Points		Points		Points			
		0	1	0	1	0	1	χ^2	p
i	f	24	76	20	72	44	148	$\chi^2 = 0.139$	$p = .710$
	f %	24.0	76.0	21.7	78.3	22.9	77.1		
m	f	17	83	13	79	30	162	$\chi^2 = 0.299$	$p = .584$
	f %	17.0	83.0	14.1	85.9	15.6	84.4		
j	f	39	61	32	60	71	121	$\chi^2 = 0.366$	$p = .545$
	f %	39.0	61.0	34.8	65.2	37.0	63.0		
e	f	24	76	21	71	45	147	$\chi^2 = 0.037$	$p = .848$
	f %	24.0	76.0	22.8	77.2	23.4	76.6		
v	f	25	75	23	69	48	144	$\chi^2 = 0.000$	$p = .000$
	f %	25.0	75.0	25.0	75.0	25.0	75.0		
k	f	19	81	15	77	34	158	$\chi^2 = 0.239$	$p = .625$
	f %	19.0	81.0	16.3	83.7	17.7	82.3		
u	f	17	83	12	80	29	163	$\chi^2 = 0.585$	$p = .444$
	f %	17.0	83.0	13.0	87.0	15.1	84.9		
d	f	17	83	15	77	32	160	$\chi^2 = 0.017$	$p = .897$
	f %	17.0	83.0	16.3	83.7	16.7	83.3		
c	f	23	77	22	70	45	147	$\chi^2 = 0.022$	$p = .881$
	f %	23.0	77.0	23.9	76.1	23.4	76.6		
r	f	14	86	15	77	29	163	$\chi^2 = 0.198$	$p = 656$
	f %	14.0	86.0	16.3	83.7	15.1	84.9		
š	f	25	75	24	68	49	143	$\chi^2 = 0.030$	$p = .863$
	f %	25.0	75.0	26.1	73.9	25.5	74.5		
p	f	13	87	12	80	25	167	$\chi^2 = 0.000$	$p = .993$
	f %	13.0	87.0	13.0	87.0	13.0	87.0		
h	f	22	78	16	76	38	154	$\chi^2 = 0.641$	$p = .423$
	f %	22.0	78.0	17.4	82.6	19.8	80.2		
g	f	25	75	20	72	45	147	$\chi^2 = 0.284$	$p = .594$
	f %	25.0	75.0	21.7	78.3	23.4	76.6		
ž	f	15	85	14	78	29	163	$\chi^2 = 0.002$	$p = .966$
	f %	15.0	85.0	15.2	84.8	15.1	84.9		
f	f	33	67	39	53	72	120	$\chi^2 = 1.803$	$p = .179$
	f %	33.0	67.0	42.4	57.6	37.5	62.8		

Table 7 shows that the difference in the perception of initial sounds in a word between boys and girls is not statistically significant in any position. Nevertheless, a lot of information can be drawn from it.

Girls were more successful in perceiving nine out of sixteen cases of initial sounds in a word (i, m, j, e, k, u, d, h, g), while boys perceived five cases of initial sounds in words (c, r, š, ž, f). When perceiving the initial sound "v" and "p" in the word, boys and girls achieved the same average.

The results in Table 7 represent the results of boys and girls in the perception of initial sounds in a word, which explicitly point to gender specific facts. Boys and girls had the most difficulties in perceiving the initial sound in a word consisting of three syllables (consonant "f", consonant, vowel + consonant, vowel + consonant, vowel). Boys were successful in only 67 % and girls in 57.6 %. The table shows that girls were the least successful with this particular word. Slightly worse, they perceived the initial "j" in a word consisting of a consonant, vowel, consonant, consonant and vowel. Boys performed similarly, as they initially perceived the initial sound in the same two words as girls, but in the reversed order. As the third word that caused problems for all participants in perceiving the initial sound in a word, was a word consisting of two syllables (consonant "š", consonant, vowel + consonant, consonant, vowel). Pupils had more difficulties perceiving initial sounds in words with a consonant cluster. The aforementioned findings of this research confirm the results of other studies, which also conclude that the performance in perceiving initial sounds in a word depends on the composition of the word. Pupils have more difficulties with multi-syllabic words (Levin, 2007; Ropič, 2016).

Boys and girls were most successful in perceiving the initial sound in a two-syllabic word (consonant / "p" /, vowel + consonant, vowel). Pupils are known to be more successful at perceiving initial sounds in a word in the case of shorter words that are non-syllabic or two-syllabic (consonant, vowel + consonant, vowel) (Levin, 2007; Ropič, 2016).

The following does not show the same sequence in the performance of perceiving the initial sound in a word in the same word between boys and girls; there is no significant deviation.

Table 8: The results of the χ^2 -test according to gender in the perception of the final sound

Final sound in a word	No. of child	Boys		Girls		Total		Result of χ^2 - test
		Points		Points		Points		
		0	1	0	1	0	1	χ^2 p
a	*f*	52	48	45	47	97	95	$\chi^2 = 0.183$ $p = .669$
	f %	52.0	48.0	48.9	51.5	50.5	49.5	
š	*f*	47	53	45	47	92	100	$\chi^2 = 0.070$ $p = .791$
	f %	47.0	53.0	48.9	51.1	47.9	52.1	
e	*f*	70	30	72	20	142	50	$\chi^2 = 1.698$ $p = .193$
	f %	70.0	30.0	78.3	21.7	74.0	26.0	
a	*f*	48	52	47	45	95	97	$\chi^2 = 0.183$ $p = .669$
	f %	48.0	52.0	51.1	48.9	49.5	50.5	
a	*f*	50	50	46	46	96	96	$\chi^2 = 0{,}000$ p = .000
	f %	50.0	50.0	50.0	50.0	50.0	50.0	
š	*f*	48	52	46	46	94	98	$\chi^2 = 0{,}077$ p = .782
	f %	48.0	52.0	50.0	50.0	49.0	51.0	
a	*f*	41	59	38	54	79	113	$\chi^2 = 0{,}002$ p = .966
	f %	41.0	59.0	41.3	58.7	41.1	58.9	
o	*f*	56	44	42	50	98	94	$\chi^2 = 2{,}053$ p = .152
	f %	56.0	44.0	45.7	54.3	51.0	49.0	
a	*f*	40	60	42	50	82	110	$\chi^2 = 0{,}626$ p = .429
	f %	40.0	60.0	45.7	54.3	42.7	57.3	
a	*f*	37	63	37	55	74	118	$\chi^2 = 0{,}209$ p = 647
	f %	37.0	63.0	40.2	59.8	38.5	61.5	
e	*f*	57	43	54	38	111	81	$\chi^2 = 0{,}056$ p = .812
	f %	57.0	43.0	58.7	41.3	57.8	42.2	
o	*f*	46	54	36	56	82	110	$\chi^2 = 0{,}924$ p = .336
	f %	46.0	54.0	39.1	60.9	42.7	57.3	
a	*f*	42	58	34	58	76	116	$\chi^2 = 0{,}510$ p = .475
	f %	42.0	58.0	37.0	63.0	39.6	60.4	
b	*f*	74	26	68	24	142	50	$\chi^2 = 0{,}000$ p = .989
	f %	74.0	26.0	73.9	26.1	74.0	26.0	
a	*f*	42	58	34	58	76	116	$\chi^2 = 0{,}510$ p = .475
	f %	42.0	58.0	37.0	63.0	39.6	60.4	
a	*f*	53	47	56	36	109	83	$\chi^2 = 1{,}209$ p = .271
	f %	53.0	47.0	60.9	39.1	56.8	43.2	

The difference between boys and girls in the perception of final sounds in a word is not statistically significant in any of the sixteen cases of the perception of final sounds. Table 8 shows that boys were slightly more successful in perceiving the following final sounds in words: "w" (s), "e" (ce), "a" (s), "w" (s), "a" (ra), "a" (ta), "a" (ba), "e" (is) and "a" (ca). Girls achieved a better average score in the perception of the final sounds "a" (la), "o" (ro), "a" (sha) and "a" (ba). It should be noted that there were small differences in the average between boys and girls. In the perception of the final sound in words "a" (ja) and "b" (mb), they achieved the same average.

The biggest gender differences were in the perception of the final sound "o" (vo) in favor of the girls; in the case of the final sound "e" (ce) boys were more successful; in the case of "a" (ca) boys were also more successful. The final sound "o" (ro) was better perceived by girls, while the difference in favor of the boys is also in the perception of the final sound in the word "a" (ta).

Boys had the most difficulties in perceiving the final sound "b" (mb) in a word consisting of a consonant cluster (consonant, vowel, consonant, consonant). There are less problems in the perception of the final sound "e" (ce) in a word consisting of a consonant, a vowel, a consonant, a consonant and a vowel. Difficulties were encountered in perceiving the final sound in words with a consonant cluster (word: consonant, consonant, vowel, consonant, consonant, vowel, or word: consonant, consonant, vowel, consonant, vowel, consonant, vowel).

The girls were similarly successful in perceiving final sounds in multi-syllabic words. It should not be overlooked that girls also have most difficulties in perceiving the final sound in a word with the same words as boys, except that the sequence is reversed.

The results show that boys and girls did not successfully perceive the final sound in the same words, although they all were most successful in perceiving the final sound "a" but in different words.

The results show that gender differences are insignificant. The success in perceiving final sounds in a word for both boys and girls is most influenced by the length of words (two-syllable, multi-syllable) and the composition of sounds in the word or a syllable. Similar findings are reported by other studies (Levin, 2007; Ropič, 2016).

It is not crucial to successfully perceive initial sounds in a word where the initial sound is a consonant. As this study shows, the participants' success is influenced by word length (multiple syllables) and syllable composition (such as, consonant, vowel + consonant, vowel or consonant, consonant, vowel + consonant, vowel + consonant, vowel). In addition, research also indicates that pupils have more difficulties perceiving initial sounds in a word when the initial sound is a vowel (Ashby et al., 2013). In this research, the following sequence was formed: boys and girls are most successful in perceiving the initial sounds "u" (before r), then "i" (before g) and then "e" (before n). Gender does not significantly affect the perception of initial sounds in a word.

Discussion and Conclusion

I was interested in whether the pupils of both groups were most successful in perceiving the same initial sounds. The results of this study do not confirm this. Pupils in G2 most successfully perceived the initial sound "p", and their peers in G1 came only in third place in the perception of the sound "p". In the first third of the results in the performance of perceiving initial sounds, it should be noted that "r" is in third place in G2 and in fifth place in G1. The performance of perceiving the initial "c" sound in both groups can be seen at the beginning of the last third. Perceiving initial sounds "j" and "f" causes the most problems in both groups of pupils. Nevertheless, it cannot be ignored that 48 % of pupils are not yet able to perceive the initial sound "f" and 45.9 % of pupils the initial sound "j".

There are some similarities in the perception of final sounds of the two groups; both successfully perceived the final sound "a" in the second part of the syllable "aba", "a" in the final syllable "ta", and "o" in the final syllable "ro". Half of the words included in the test measured the ability to perceive the final sound "a" in the syllable "na", then "o" in the final syllable "vo". On the 13^{th} and 14^{th} place in the successfulness of both groups is the perception of final sounds in same words, namely "a" in the final syllable of the word, "ca", and the final sound "e" in the final syllable of the word, "je". A similar level of ability to perceive the final sound can also be detected in the same two words in the two groups that were most difficult for pupils. This is the final sound "e" in the final syllable "ce" and "b" in the final syllable "mb" in the word. In both cases of the final sound "š", first in the final syllable "iš" and second in the final syllable "oš" in the word, the pupils of both groups were moderately successful, although some studies say that the students can easily perceive final sounds that are consonants (Ashby et al., 2013). This research cannot confirm that.

Some studies indicate that students can use one-syllable or non-syllable words to perceive final sounds (Levin, 2007). My study confirmed this as well, since the pupils of both groups most easily perceived final sounds of words that are composed of two syllables (consonant–vowel, consonant–vowel). Similarly, pupils of both groups had significantly greater difficulty in defining the voice in two-syllable (a syllable with consonant set) and three-syllable words.

This study concludes that there is no statistically significant difference in the perception of initial and final sounds between boys and girls. It also indicates that boys and girls have difficulties in perceiving the initial and final sounds in multi-syllabic words and words in which consonant clusters occur.

There are large differences among the first-grade pupils in the ability to perceive initial and final sounds. That makes it imperative to differentiate and individualize lessons. If the teachers perform phonological awareness tests, they will learn the students' abilities and be able to plan individualized exercises for developing phonological awareness.

Although I found a significant difference between the groups of first grade students in their ability to perceive initial and final sounds in a word, they all began the process of systematic literacy at the same time. This raises the further question of whether the pupils of G1 will be able to develop phonological awareness during the literacy period in their education or their reading and writing problems will deepen.

References

Ashby, J., Dix, H., Bontrager, M., Dey, R., & Archer, A. (2013). Phonemic awareness contributes to text reading fluency: Evidence from eye movements. *School Psychology Review*, *42*(2), 157–170.

Ball, E. W. & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Reading Research Quarterly*, *26*(1), 49–66.

Bider Petelin, I. (2014). Ugotavljanje predbralnih zmožnosti [Determining pre-reading abilities]. *Sodobna pedagogika*, *65*(131), 24–40.

Božič, A., Habe, K., & Jerman, J. (2007). Povezanost glasbenih sposobnosti in fonološkega zavedanja pri predšolskih otrocih [The connection between musical abilities and phonological awareness in preschool children]. *Psihološka obzorja*, *16*(1), 39–52.

Chard, D. J. & Dickson, S. V. (1999). Phonological awareness: Instructional and assessment guidelines. *Intervention in School and Clinic*, *34*(5), 261–270.

Cardoso-Martins, C., Mesquita, T. C. L., & Ehri, L. (2010). Letter names and phonological awareness help children to learn letter-sound relations. *Journal of Experimental Child Psychology*, *109*(1), 25–38. https://doi.org/10.1016/j.jecp.2010.12.006

Graaff, S., Hasselman, F., Bosman, A. M. T., & Verhoeven, L. (2007). Cognitive and linguistic constraints on phoneme isolation in Dutch kindergartners. *Learning and Instruction*, *18*(4), 391–403. https://doi.org/10.1016/j.learninstruc.2007.08.001

Kurikulum za vrtce [Curriculum for kindergartens]. (1999). Ljubljana: Ministrstvo za šolstvo, znanost in šport, ZRSŠ.

Levin, I. (2007). The role of Hebrew letter names in early literacy: The case of multiphonemic acrophonic names. *Journal of Experimental Child Psychology*, *98*(4), 193–216. https://doi.org/10.1016/j.jecp.2007.09.001

McGee, M. L. & Ukrainetz, A. T. (2009). Using scaffolding to teach phonemic awareness in preschool and kindergarten. *The Reading Teacher. 62*(7), 599–603. https://doi.org/10.1598/RT.62.7.6

Mesmer, H. A. E. & Griffith, P. L. (2005). Everybody's selling it -But just what is explicit, systematic phonics instruction? *The Reading Teacher*, *59*(4), 366–376.

Rohl, M. (2000). Learning about words, sounds and letters. In C. Barratt-Pugh & M. Rohl (Eds.), *Literacy learning in the early years* (pp. 57–80). Buckingham: Open University Press. 57–80.

Ropič, M. (2014). Children's ability in awareness of the initial and final sound in word. *Švietimas*, *17*(2), 8–17.

Ropič, M. (2016). The ability to perceive initial and final sounds in non-syllable and multi-syllable words. *Didactica Slovenica – Pedagoška obzorja*, *31*(1), 44–55.

Ropič, M. (2017). The development of certain levels of phonological awareness in the preschool period. In D. Haramija (Ed.). *Reading literacy in preschool and education* (pp. 57–66). Maribor: Pedagoška fakulteta v Mariboru.

Strickland, D. S. (2011). Strategies for beginning readers and writers and those needing additional support and intervention in teaching phonics today. In D. S. Strickland (Ed.), *Teaching phonics today: Word study strategies through the grades* (pp. 50–64). Newark, DE: International Reading Association.

Tafa, E. (2008). Kindergarten reading and writing curricula in the European Union. *Literacy*, *42*(3), 162–170.

Curriculum. Slovene. (2011). Ljubljana: Ministrstvo za šolstvo, znanost in šport, ZRSŠ.

Venn, E. C. & Jahn, M. D. (2004). *Teaching and learning in preschool: Using individually appropriate instruction in preschool.* Newark, DE: International Reading Association.

Development of Professional Vision in Art Education Video Interventions

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Abstract The study investigates the professional vision of pre-service, elementary-school, art-education teachers and presents a video-intervention methodology based on a wider transdidactic approach. The author uses a concept of the professional vision, well-known in teaching mathematics and sciences and seeks to establish it in the domain of Art Education. The study analyzes thirty-four student-written reflections based on watching a video recording of an art education lesson using a modified Stockero´s categorical system. The study shows what subject-specific phenomena the students notice in comparison with the experts, and focuses on how they reflect them. The results demonstrated a low number of noticed phenomena with a low ability of the knowledge-based reasoning. The findings were used to develop a video-intervention methodology at the Faculty of Education of the Charles University, Prague, with the aim of improving the professional vision of pre-service teachers. The text presents briefly the video-intervention methodology.

Keywords: art education, professional vision, reflective practice, video-intervention, pre-service teachers.

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Introduction

Video-interventions are one of the forms of practice-based education of pre-service teachers. The complex educational situations are shown to pre-service teachers on a video recording. In order to analyze those, it is necessary to use the frame enabling the students to make relations to the individual moments or phenomena. Paying attention to such situations in education and their reflection represent teacher's skills that are important for high-quality teaching. Those skills are connected with the ability to reflect on whose importance has been stressed in education since 1980s. Reflective approach is often used in the teacher's training; for instance, it is the key element of student's practices. Nowadays, many authors pay attention to professional vision in the education as evidenced by numerous studies in mathematics, biology and other subjects.

The presented study is a part of a broader, transdidactically-oriented research, realized at the Faculty of Education of the Charles University, Prague. The following text describes the professional vision of pre-service, elementary school teachers in art education with the aim to map their qualifications. A low level of art education in Czech elementary schools has been stressed many times, for example, Šobáňová (2016). One of its reasons can be a low quality of professional skills of the teachers.

The concept of professional vision was introduced by Goodwin (1994) in the context of linguistic anthropology as a set of discourse procedures that the subjects use to structure important phenomena in order to be able to understand them. In connection with the education of teachers, Sherin and van Es (2009) mentioned two subprocesses, namely noticing and knowledge-based reasoning. Experts understand noticing as a process of distinguishing important and less important phenomena in the education. Reasoning about the noticed reality relates to the teacher's ability to evaluate and interpret the situations in the education. The professional vision is a dynamic interaction that affects the teacher's thinking and action. In the context of professional training of the teachers of mathematics, Stockero (2008) confirmed the effect of analysis of the videos on the level of reflection and attentiveness given to the pupil's thinking. It has been shown that even a short video-course has an impact on the noticing skills of participants, such as more specific comments, more attention to subject-specific thinking and less on pedagogy, more attention to pupils and less to the teacher (Stockero, 2008). The literature also describes the shift of videoclub participants from the evaluation of situations to their interpretation (Sherin & van Es, 2009; Stockero, 2008), while interpretations occur less often, and most interpretations are naive statements (Uličná 2017). Blomberg et al. (2011) show also that the skill of professional vision is subject-specific. They highlight the possible link between choosing a field of study and how and what future teachers of the given field perceive during the lesson. Robová and Novotná (2018) compared what attitude students of two different subjects of study, the art education and mathematics, adopted in the video-interventions.

Video-interventions can take different forms. Some video-interventions allow participants to view their own videos or videos of colleagues. In others they can watch video recordings of other people.

Simpson and Vondrová (2019) distinguish two different approaches in video-intervention methodology, one based on situated cognition and the second on cognitive learning theories.

The first approach understands learning as grounded in authentic activity and accentuates the inquiry and communities of practice. Bloomberg et al. (2014) thus encourage open reflections on videos. The second approach, based on cognitive learning theory, uses videos as illustrations of the previously studied theory. It includes explicit frameworks for a more structured analysis of videos, implicitly directing the attention (Santagata & Guarino, 2011; Stockero et al., 2017).

Method

The research seeks to investigate which phenomena and situations pre-service teachers (from now on, PST) notice in art education lessons, compared to the experts. The expert group included six researchers and two lecturers from the Department of Art Education, Faculty of Education, Charles University, Prague. The survey analyzed written reflections of PST based on the observation of a video of a lesson in art education.

The survey questions were the following:

1. What phenomena do PST notice in the video of the art education lesson, compared to the experts?
2. What do they think about the noticed phenomena?
3. What theoretical knowledge do PST use to explain the noticed reality?

Participants

A total of 34 PST in their fourth year of a 5-year study took part in the art education research. All of them were students who frequented art aducation courses in two study groups. Two students did not deliver the reflections. The selection of participants was made to map their professional vision at the end of the professional education before starting their educational job.

Instrument: Description of the Video-recorded Lesson

I used videos of authentic classroom situations to capture PST's noticing skills. Some researchers (for example, Schäfer & Seidel, 2015) use short clips, others use whole lessons (for example, Star et al., 2011). I used the video recording of a whole 45-min art education lesson that took place in Grade 7, specialized in arts and digital technologies. The lesson was chosen as it included a number of interesting features related to the subject. However, it was not an example of a good practice.

The video-recorded lesson started with a presentation of the three-month project focused on the photographic portrait. Then the comprised lessons, aids and materials were planned. The teacher opened the lesson with questions, such as: "What face is it?" The pupils put down their associations individually. Quotations of famous authors served for inspiration, such as Zenon's quote: "That's why we have two ears and one mouth to listen more and speak less." Then the pupils discussed their observations and collectively formulated the main ideas.

Figure 1: Group work in the classroom. The teacher discusses quotes with pupils.
Source: Own.

A partial task helped the pupils to talk about their own identity. In the next part of the lesson, the teacher assigned a partial art task. It extended the previous brainstorming into the material creation and led pupils to think about the following questions: Who am I? How do others see me? How do I see myself? The pupils took photographs of each other. The printed photos were then used to make collages that would express their personal characteristics. The ground colour characterized the author´s personality.

Figure 2: Examples of the artwork
Source: Own.

The Expert Phenomena: Identification of Important Moments

In order to be able to explore PST's noticing and reasoning, it was necessary to identify what was considered important by the experts. In order to distinguish the content-specific important moments in the lessons, the experts first had to negotiate their ideas of quality teaching in their subjects. The selection of specific phenomena for the expert comparison was realized on the basis of consensus of the whole research team. Six most significant phenomena were selected for each subject. Then particular codes were assigned to them (see Table 1).

Table 1: Expert phenomena, examples of PST's comments

AE1	Wider Art project	Enables the teachers to use a deeper approach in a limited number of AE lessons per week. Pupils are taught to think contextually. Hard to plan and reflect. Notes made by the pupils.
	Example	"First it seemed to be strange how, at the beginning, the teacher dictated to the pupils what they should expect in the next lessons but then it well matched the context of the whole lesson."
AE2	Art production – a necessary part of AE lesson	The core of the phenomenon is a stereotype assumption that an AE lesson must include a creative activity. Creation is considered to be a cognitive process of cultural transformation and making of the meaning.
	Example	„Never it occurred to me that other things except the creation, painting etc. could also be a part of an AE lesson."
AE3	Communication in AE lesson	Meaning making and semiotics; communicative dimension of the AE curriculum.
	Example	A situation can be seen when children say to each other what they know about him/her."
AE4	Unclear task instructions	Teacher changes the instructions. The process of instructing pupils is unclear. Pupils do not understand the instructions.
	Example	"In this stage the teacher changes the instructions of the task about four times and the pupils seem to be confused. It takes about 15 min for all groups to finish the task. I suggest that the teacher writes the instructions on the blackboard and thus prevents the pupils from receiving different instructions."
AE5	Lesson topic	The lesson content is related to the inquiry about one´s identity. Portrait is a classical form of its expression.
		"Each pupil had to give a thought to him- or herself and probably found out something new, which was important in his/her opinion. To express something linked to him or her, what the others did not see or know, was a bit intimate, but it matters in the art -to express one´s opinion, feelings, ideas, etc."
AE6	Pupils´comments	PST noticed pupils´comments.
	Example	"Example of a pupil´s statement: 'The face determines the human identity, it expresses his/her spirits, importance of the listening (two ears and one mouth).'"

Note: AE, art education.

Data Collection

The task of reflecting on the video was assigned to the students as follows: "You can see the video recording as many times as you want. Then write a reflection about the recording; the extent of the text is not limited. You should mention what you found interesting and what was important from your point of view. Do not be afraid to present your views, there is no correct answer. You will not be evaluated on the basis of the text you write. I would ask you to formulate your opinion in whole sentences." The students were working at home and the texts were handed in electronically.

Data Analysis

The students' texts were divided into semantic units always including only one phenomenon. If a student expressed the opinion concerning a phenomenon several times, their comments were involved in one unit. The split was done by one researcher and another one checked the validity. Any inconsistencies were negotiated. In that way a total of 87 units were established.

Coding the Noticing and Reasoning about Expert Phenomena

In order to identify the nature of reasoning, I used a framework based on Stockero (2008). I kept the codes of description, explanation, and theorizing and omitted the codes of confronting and restructuring that I could not see in the collected data.[1] I added three aspects of the data which were not explicitly included in Stockero´s framework: evaluation, alteration[2] and prediction (Table 2). The comments classified as description and evaluation were considered to be of a lower quality than those of explanation and theorizing, as PST did not connect what they observed by using their subject-specific or general knowledge. One comment could be integrated into several codes. An example can be the following statement that was coded as a description, explanation and alteration: "At the beginning of the lesson the teacher dictates to the pupils what will happen in the course of future lessons. It seems to me that by doing that the teacher lost precious time that could be spent on art

[1] Stockero analyzed group discussions which, presumably, were richer than the individual responses.
[2] This is a part of Stockero's Restructuring, but many alternative actions suggested by our PST were naïve or general and thus hardly provided signs of restructuring.

production. Perhaps the pupils could better be given a printed plan of lessons."

Table 2: Coding framework

Code	Characterization
Description	Recounting of what can be seen in the video.
Evaluation	Subjective judgment of what was seen in the video, without reasoning why.
Explanation	Naïve explanation of what was seen in the video, or explanation based on one's own experience as a pupil or as a teacher.
Theorizing	Generalization of what was seen in the video. Some theorizing is necessary (use of professional terms, pedagogical concepts).
Alteration	Any suggestion of an alternative action to what is happening in the lesson.
Prediction	Connection of what was seen in the video with a future state, for example, what effect the event might have on pupils' future understanding or use of the subject matter.

Research results

Noticing of Important Moments

Figure 3 shows what phenomena PST notice. Most often they include AE5 – Face and identity (76 %) and AE1 – wider art project (74 %). Less than one half of PST took notice of the AE4 (unclear assignment of the task, 47 %) and AE2 phenomena (the lesson did not include visual art production, 38 %). Few students took notice of the communication dimension of the lesson (AE3, 12 %) and the concrete statements of the pupils (AE6, 9 %).

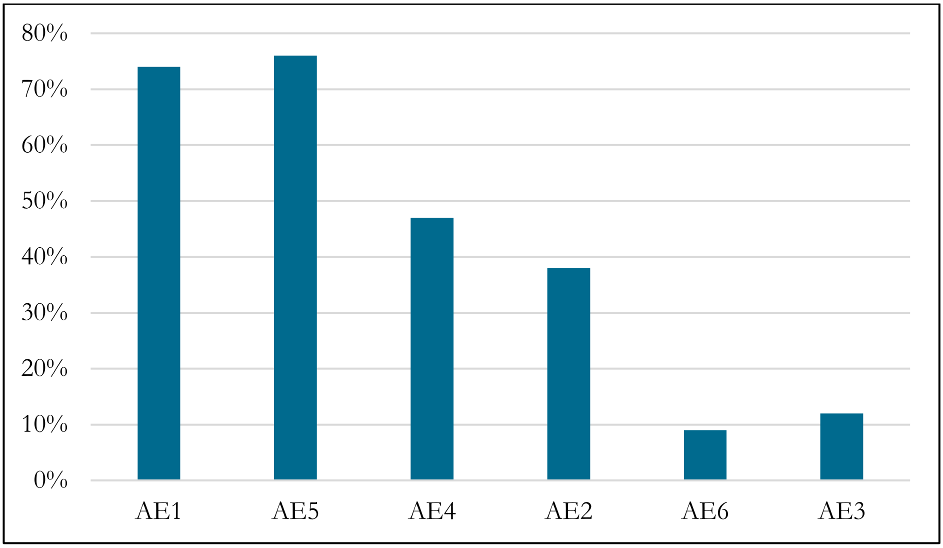

Figure 3: Relative numbers of commented expert phenomena

The data suggest that, in average, the students noticed 2.6 specific phenomena out of a total of 6. No PST noticed all 6 phenomena. All PST noticed at least one expert phenomenon. Considering the extent of the text, the combinations of the noticed phenomena that are a part of the data are not mentioned. However, they showed that PST who noticed only one phenomenon always noticed either AE1 or AE5, i.e. the phenomena that were noticed most often of all. I therefore think that those phenomena were well noticeable.

Knowledge-based Reasoning

Figure 4 shows what level of reasoning was achieved by PST. It can be seen that 16 % of comments were classified as belonging to the description code and 30 % were evaluation statements. The relative amount of explanation statements that reflected one´s experience but not the theory, reached 44 %. Only 10 % of the comments could be considered to be theorizing reflections.

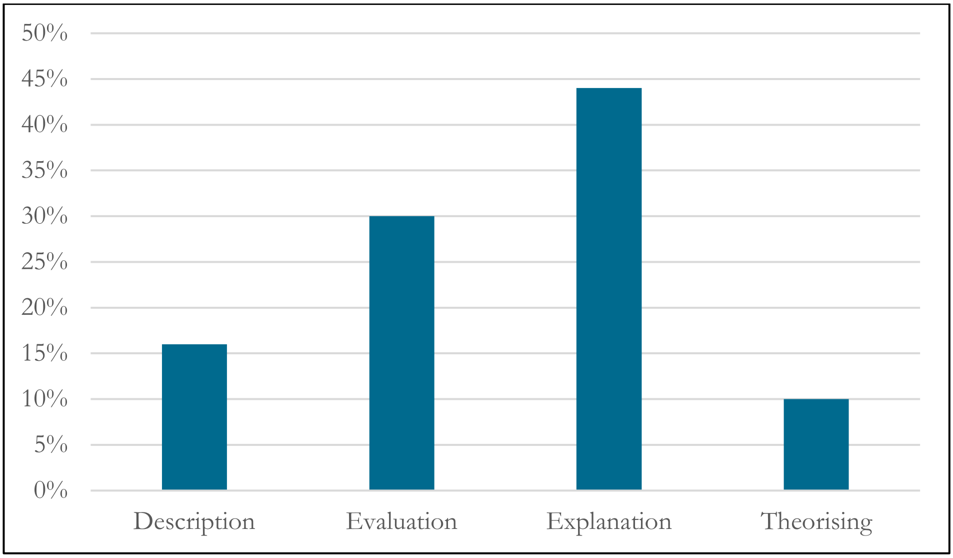

Figure 4: Levels of knowledge-based reasoning

Theorizing

It can be seen that students rarely theorized. Evidently, they did not see the theory studied in the context of the educational situations and were not able to use it well for providing the reasons. Most often the students theorized about the AE5 phenomenon or about the lesson content. If the phenomena that the students theorized about little or not at all were studied, researchers could get information on the so-called white sites. They represent questions for which PST did not find any support in the theory, namely the questions of visual production, communication in the art education and the meaning making.

Alteration and prediction

Alteration and prediction are considered to be a higher level of thinking since they provide the reasons. In case a PST suggests an alternative solution of the educational situation, he/she must consider what would be prevented by making the change. The data show that the alteration and prediction were most often coupled with the explanation. Figure 5 shows that the relative values when PST were using alteration and prediction, 23 % and 21 %, respectively, were higher than those of the theorizing. The phenomena when alteration was used most frequently were AE1, AE4 and AE5. Predictions were also most often related to those phenomena. They mostly represented practical suggestions like: "At this stage the teacher changed the assignment about four times and the pupils look confused. All groups finished the task within 15 min. I suggest that the teacher puts down the assignment on the blackboard and thus precludes providing another assignment to the pupils."

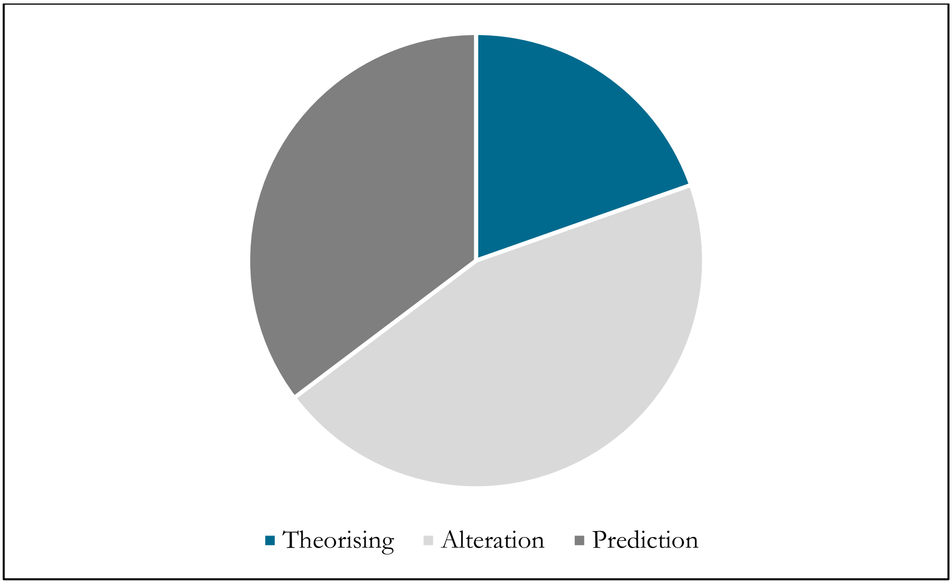

Figure 5: Higher-level, knowledge-based reasoning

Discussion and Conclusion

The PST noticed a low number of phenomena, on average 2.6 phenomena out of a total of 6. The study of Vondrová and Žalská (2015) also monitored the phenomena with a low rate of noticing and discussed the connection with the way how the phenomena had been selected. Star et al. (2011) mentioned a rate of 53 % of the noticed phenomena and distinguished more and less important situations in the education process.

In their reflections, PST most often focused on the planning and structuring of the visual art project and on its topic, but less on the role of the teacher in the assigning of tasks. PST repeatedly expressed surprise at the record in the exercise book in the art education lesson: "I was quite surprised that almost one lesson dealt only with speaking, thinking and preparatory works. I have never seen this…"

I assume that this phenomenon could be caused by the fact that the previous didactic study was aimed practically. PST learned to plan visual art tasks. However, they did not pay attention to the fact how the teacher implemented the task planned. The video recording used was a suitable tool for a discussion about project planning. The issue of planning in the integrated art education is mentioned in the studies of Kafková (2013) and Roeselová (1997). The broader visual art projects enable us to make a deeper insight in the topic even in the case of a small number of lessons per week. They teach the pupils to think in the context, to link gradually acquired experiences and to compare various solutions. They are demanding, with respect to the planning done by the teacher, by combining various approaches and a reflection (Kitzbergerová, 2014).

Only 15 % of the comments concerned art production (AE2). None of them had a solid support in the theory. It is evident that PST do not consider art production to be a cognitive process or a process of cultural transformation of the content (Goodman, 1996; Slavík, 2013): "It may be a little conservative, but for me art is all about creation. The concept is certainly good for artwork, but in this lesson, it was more about creating the idea, thinking about work, rather than about art itself."

The video recorded only the introduction of the project. The lesson was not primarily focused on the art production. The criticism of the absence of the art production in the lesson is not appropriate. However, the idea that an art education lesson has to include a material production by the pupils is deeply rooted. An idea that the art education lesson is aimed at receptive actions in the sense of the interpretation of artifacts was not widely accepted by PST, even though gallery and museum pedagogy has become a part of the art education (Fulková, 2019; Wagner & Schönau, 2016).

In reflections, PST gave the opinion on the unclear assignment of the task (AE4). The statements reflected that the teacher, in reaction to the students' questions, repeated the same assignment and did not detail it or formulate in a different way: "When assigning the task- collage, the teacher repeats it twice. Unnecessary. Why didn't she say it once? Pupils could have written it on the blackboard or on the paper for the second time. Why didn't one of the pupils repeat the assignement instructions the second time?"

The video-recorded situation well illustrated the fact that the art task assignment is a process of a mutual clarification of the ideas between pupils and the teacher, in contrast to other subjects where the task has a clear and brief form of the assignment. PST have not yet realized this aspect of art education.

The lowest rate of noticing exhibited communication in art education lesson (AE3) and pupils' comments (AE6). In connection with this finding (see Šobáňová, 2016) I assume that, if PST did not reflect the communication dimension of the lesson and meaning making, there is a risk that they will not include those aspects in their own teaching. PST are blind to pupils´comments. It is surprising in a lesson that was mostly devoted to a discussion, where many views of the pupils are presented. Unfortunately, the photodocumentation of quotations did not make a part of the video recording. The studies of Blomberg et al. (2011), Stockero (2008) and Novotná (2017) also pointed out the dominance of general statements over the specific ones. I am confident that an important task of the subject didactics in the art education is a development of PST in the area of semiotics and visual symbols and in strengthening of the communication component of the art education.

Figures 4 and 5 show a high rate of non-justified reasoning, a high rate of naïve explanation and a low rate of complex thinking. Similar findings concerning elementary-school teachers, pre-service teachers of mathematics and pre-service English-language teachers were reported by other authors, namely Pavlasová et al (2018), Santagata and Guarino (2011). I am convinced that the "oriented" noticing of educational situations connected with the proposing of alternative solutions, the interest in pupils' thinking and the capacity to its prediction lead to the development of more complex thinking of PST.

The results indicate that PST were not able to duly use their theoretical knowledge when they should have provided reasons to justify the phenomena observed. It opens the discussion about the role and form of the theory in teacher´s training (Slavík et al., 2014). The question of selection of a suitable theory for the professional formation of teachers matters here. The results of the analysis showed that PST did not comment on the subject matter of the lesson. The key term "portrait" appeared in the reflections only nine times, which is not much, as the term was used in the lesson repeatedly.

Here I can see space for a better aiming of the professional subject skills. PST did not think about the medium of photography, its role in the lesson, the possibilities, the approach, the portrait photography, they were not writing about the application of the medium of photography. The relation between the form and the content in art is thought as the key one (see Eisner, 2004; Gajdošíková, 2019) and nowadays as inseparable. In my analysis, it was noticeably easier for the students to use their knowledge obtained in the planning of the teaching and in the use of the project method in the lesson, i.e. in the practically-focused teacher's skills.

Video-interventions should be a way to link the practice with the theory (Korthagen et al., 2011) and to develop PST metacognition (Janík et. al., 2016; Sherin & van Es, 2009; Stockero, 2008). In led discussions, it was possible to contextualize selected phenomena. PST praised such occasions in the professional training (Robová & Novotná, 2018). The issue of video-interventions is dealt with in the studies of Simpson and Vondrová (2019), Pavlasová et al. (2018), among others. The concept has been worked out in a broader research team that started in 2016. It was included in the teacher's training in the form of optional courses. PST worked in small collaborating groups in the course of one semester. The work was divided into five common sessions. PST prepared for each session by individually watching video recordings of their own teaching, or they watched videos of others. PST first individually analyzed the watched videos in the written form. The individual reflections were then discussed in a group according to a unified scaffolding that supported the noticing and knowledge-based reasoning. The group discussions brought forward collaborative reflection that confronted preconceptions and a concrete peer feedback. Generally, the principle of video-interventions are the cycled reflections situated in practice.[3]

The results obtained describe the level of professional vision of pre-service, elementary-school teachers in art education, compared to the expert vision. The data show a low number of the noticed phenomena. It can be seen that PST paid little attention to the communication dimension of the art education. A large amount of unjustified comments was also observed. PST exhibited a low capability of application of the theoretical knowledge to give reasons for their observations.

The results cannot be generalized as it must be kept in mind that the investigation included a limited sample of students at one university during one academic year only. On the other hand, the sample included all students in one grade. It is therefore possible to think of a preparedness of the whole group of students to teach the art within the art education profession. The conclusions can be affected by the selection of specific phenomena as well as by their number, however, I tried to avoid this problem methodologically. Other forms of the resulting statements of the students (e.g. discussion) could lead to different statements. The noticing of the phenomena was clearly affected by the selection and technical parameters of the video recording. The interpretation of the results thus must be understood in connection with the description of the recorded lesson. In connection with the conclusions drawn, a methodology of video-interventions that has been developed during the last three years is presented.

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References

Blomberg, G., Stürmer, K., & Seidel, T. (2011). How pre-service teachers observe teaching on video: Effects of viewers' teaching subjects and the subject of the video. *Teaching and Teacher Education*, *27*(7), 1131–1140. https://doi.org/10.1016/j.tate.2011.04.008

Eisner, E. W. (2004). What can education learn from the arts about the practice of education? *International Journal of Education & the Arts*, *5*(4), 1-13.

[3] The publication of a monograph on video-interventions is planned for 2020.

Fulková, M. (2018). Pomalé pozorování a neúsilné soustředění: Několik poznámek k didaktické výstavbě obsahů učiva v galerijním vzdělávání [Slow observation and non-effort concentration: Some notes on the didactic building of the education content in the gallery education]. In D. Čarná, & B. Tribulová (Eds.) *Otvorená galéria: Zborník z konferencie galerijnej pedagogiky* [Open gallery: The proceedings of the conference of gallery pedagogy], (pp. 12-21). Bratislava: Kunsthalle Bratislava.

Gajdošíková, P. (2019). *Fenomén architektury ve vlastním uměleckém a pedagogickém díle: Pedagogické implikace* [Phenomenon of architecture in one's own art and pedagogical work: Pedagogical implications] (Publication No. 169727). [Doctoral dissertation, PedF UK]. Repozitář závěrečných prací [Repository of theses].

Goodwin, C. (1994). Professional vision. *American Anthropologist*, *96*(3), 606–633.

Goodman, N. (1996). *Ways of worldmaking.* Bratislava: Archa.

Janík, T., Minaříková, E., Píšová, M., Uličná, K., & Janík, M. (2016). *Profesní vidění učitelů a jeho rozvíjení prostřednictvím videoklubů* [Professional vision of teachers and its development using videoclubs]. MUNI Press.

Kafková, H. (2013). Institutionalized significations and creativity. Diálogos com a arte, 3 (3), 249–260.

Kitzbergerová. L. (2014). *Didaktika výtvarné výchovy* [Didactics of art education]. Retrieved from http://uprps.pedf.cuni.cz/UPRPS-353-version1-didaktika_vytvarne_vychovy.pdf

Korthagen, F. A. J., Kessels, J., Koster, B., Lagerwerf, B., & Wubbels, T. (2011). *Linking practice and theory: The pedagogy of realistic teacher education.* Brno: Paido.

Novotná, M. (2017). Professional vision of pre-service teacher students in the art education. *E-pedagogium*, *3*, 111–123. https://doi.org/10.5507/epd.2017.041

Pavlasová, L., Stará, J., Vondrová, N., Novotná, M., Robová, J., & Uličná, K. (2018). Výběrové zaměření pozornosti u studentů učitelství a povaha jejich interpretací [The selective attention of pre-service teacher students and the nature of their interpretations]. *Pedagogika*, *68*(1), 5–24. https://doi.org/10.14712/23362189.2017.625

Robová, J., & Novotná, M. (2018). Benefits of videoclubs for future teachers training. In J. Fejfar, M. Fejfarová, M. Flégl, M. Houška, J. Husák, I. Krejčí & H Urbancová (Eds.), *Proceedings of the 15th international conference: Efficiency and responsibility in education 2018* (pp. 299–306). Czech University of Life Sciences Prague.

Roeselová, V. (1997). *Řady a projekty ve výtvarné výchově* [Rows and projects in art education]. Prague: Sarah.

Santagata, R., & Guarino, J. (2011). Using video to teach future teachers to learn from teaching. *ZDM*, *43*(1), 133–145. https://doi.org/10.1007/s11858-010-0292-3

Schäfer, S., & Seidel, T. (2015). Noticing and reasoning of teaching and learning components by pre-service teachers. *Journal for Educational Research Online*, *7*(2), 34–58.

Sherin, M., & van Es, E. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education*, *60*(1), 20–37. https://doi.org/10.1177/0022487108328155

Simpson, A., & Vondrová, N. (2019). Developing pre-service teachers' professional vision with video interventions: A divergent replication. *Journal of Education for Teaching*, *45*(5), 1–18. https://doi.org/10.1080/02607476.2019.1674563

Slavík, J. (2013) Úvod [Introduction]. In J. Slavík, V. Chrz & S. Štech (Eds), *Tvorba jako způsob poznávání* [Art production as a way of recognition] (pp. 11–26). Prague: Karolinum.

Slavík, J., Janík, T., Jarníková, J., & Tupý, J. (2014). Zkoumání a rozvíjení kvality výuky v oborových didaktikách: metodika 3A mezi teorií a praxí [Analysing and improving instructional quality in subject matter didactics: A 3A model between theory and practice]. *Pedagogická orientace*, *24*(5), 721–752. https://doi.org/10.5817/PedOr2014-5-721

Star, J. R., Lynch, K., & Perova, N. (2011). Using video to improve pre-service mathematics teachers' abilities to attend to classroom features: A replication study. In M. G. Sherin, V. R. Jacobs & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 117−133). New York: Taylor & Francis.

Stockero, S. L. (2008). Using a video-based curriculum to develop a reflective stance in prospective mathematics teachers. *Journal of Mathematics Teacher Education*, *11*(5), 373–394. https://doi.org/10.1007/s10857-008-9079-7

Stockero, S. L., Rupnow, R. L., & Pascoe, A. E. (2017). Learning to notice important student mathematical thinking in complex classroom interactions. *Teaching and Teacher Education*, *63*, 384–395. https://doi.org/10.1016/j.tate.2017.01.006

Šobáňová, P. (2016). *Realizované* vs. předepsané kurikulum – reflexe kurikulární reformy a její implementace do praxe [Realised art education curriculum versus framework educational programme for basic education]. In P. Šobáňová (Ed.), *Současný stav a perspektivy výtvarné výchovy: Reflexe kurikulárních dokumentů pro všeobecné vzdělávání* [Current state and perspectives of art education: A reflection of curricular documents for general education] (pp. 27–52). INSEA, Palacký University Olomouc.

Uličná, K. (2017). Professional vision: focus on knowledge-based reasoning. *Proceedings of ERIE 2017*, 482−489.

Vondrová, N., & Žalská, J. (2015). Ability to notice mathematics specific phenomena: What exactly do student teachers attend to? *Orbis scholae*, *9*(2), 77−101.

Wagner, E., & Schönau, D. (Eds.) (2016). *Common European framework of reference for visual literacy -prototype*. Münster: Waxmann.

WHAT DO SLOVENIAN AND CROATIAN TEACHERS KNOW ABOUT MATHEMATICAL MODELLING?

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Abstract In today's world, mathematical modelling is essential, and it is necessary to learn how to model. Therefore, considerable efforts must be made to make the mathematical modelling process understandable to all students. Almost all education systems are striving in this direction. Nevertheless, there is still relatively little modelling in early mathematics teaching practice. The paper describes what mathematical modelling is in the context of early mathematics and the benefits it brings to students. The survey was conducted in Slovenia and Croatia on a sample of 887 teachers in the first four/five years of elementary education. The participants answered questions on the general meaning of the term mathematical modelling as they understand it. After the answer, we provided the teachers with the definition of mathematical modelling. We then set up claims about mathematical modelling with which teachers could either agree or disagree on the five-point Likert scale. Finally, the teachers answered some questions about the obstacles in teaching mathematical modelling. The results of the study suggest that teachers in both countries feel a lack of professional skills to teach mathematical modelling efficiently. Besides, the results show the advantages of explicit attention to modelling in the curriculum documents.

Keywords: mathematics, cross-country comparison, curricular documents, teachers' beliefs, socially desirability bias.

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Introduction

Mathematics has been developed to describe the world almost from the beginning of human existence. Processes such as constructing, reasoning, predicting, guessing, organising data, quantifying, and so forth, are becoming increasingly more essential processes in the life of every person. English and Watters (2004) have stated that mathematical modelling provides a rich source of opportunity for developing these crucial processes. The fact that applications and modelling have been, and continue to be, central themes in mathematics education is not at all surprising. Nearly all questions and problems in mathematics education, that is questions and issues concerning human learning and the teaching of mathematics, influence and are influenced by relations between mathematics and some aspects of the real world (Niss et al. 2007, p. 22).

This essential interrelationship between the real world and mathematics has been recognised as of critical importance by many in education and educational research and has given rise to a sub-field of educational research related to the teaching and learning of mathematical applications and mathematical modelling. Niss et al. (2007) suggested that the *ICMI Study on modelling and applications in mathematics education* from 2004 might "formally mark the maturation of applications and modelling as a research discipline in the field of mathematics education" (p. 29). Niss et al. (2007) define applications (and modelling) as being when mathematics is applied to some aspect of the extra-mathematical world for some purpose including "to understand it better, to investigate issues, to explain phenomena, to solve problems, to pave the way for decisions, and so on" (Niss et al. 2007, p. 24).

Mathematical modelling conceived as real-world problem-solving is the process of applying mathematics to a real-world problem with a view of understanding it (Niss et al., 2007). It is more than using mathematics where we also start with a real-world problem, apply the necessary mathematics, but after having found the solution we no longer think about the initial problem except to check if our answer makes sense. With mathematical modelling, the use of mathematics is more for understanding the real-world problem/situation. The modeller also poses the problem(s) and questions (Stillman, 2019). In line with the described emphasis, we have decided for the following definition: "Mathematical modelling is an iterative process that involves the open-ended, real-world, practical problems that students make sense of with mathematics using assumptions, approximations, and multiple representations. Other sources of knowledge besides mathematics can be used as well" (Stohlmann & Albarracin, 2016, p. 2). To better illustrate the process of mathematical modelling, we can use the cycle of mathematical modelling from Blum and Leiss (2007) in Figure 1.

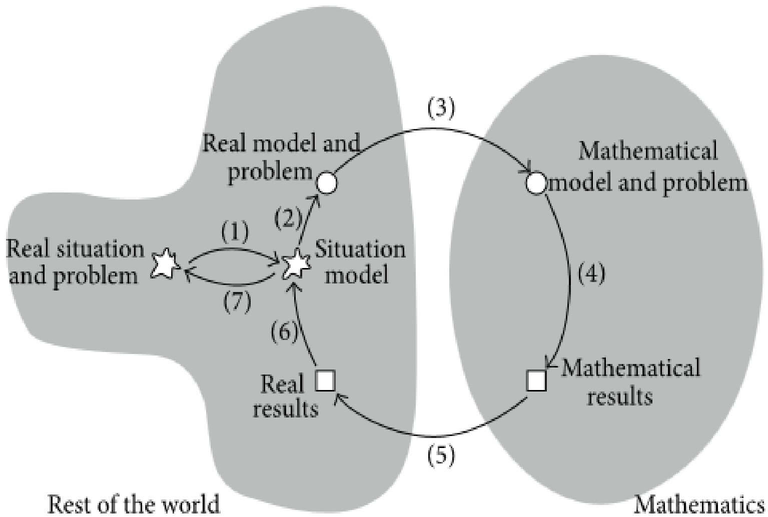

Figure 1: The mathematical modelling cycle according to Blum and Leiß (2007, p. 225)

In the modelling circle, we begin with the problem that is to be solved using math tools. In the first stage, the problem is described by relevant non-mathematical terms. During this phase, it is necessary to choose (simplify) assumptions. The outcome of the first phase is the conceptual model. This conceptual model is then translated into a mathematical model that can be mathematically analysed.

Furthermore, the mathematical solution is translated back into the language of the initial problem, which is called interpretation. Finally, we confirm the answer. If necessary, we will again begin the modelling circle by adjusting one or more steps (Spandaw & Zwaneveld, 2009).

Example: ***Uwe Seller's foot.*** The relevance of metacognition has increased in the context of mathematical modelling. It is essential to involve metacognitive activities during modelling processes to support modelling competencies. Concerning this, Blum (2011) underlines: "There are many indications that meta-cognitive activities are not only helpful but even necessary for the development of modelling competency" (Blum 2011, p. 22). In the example, Uwe Seller's foot, the importance of metacognitive skills is visible (Figure 2). The example shows several characteristics of students' as well as teachers' metacognitive skills (Vorhölter and Schwartz, 2020; Wendt et al., 2020)

Since August 2005, there has been a sculpture of the right foot of Uwe Seeler, a famous German soccer player, in front of the football arena in Hamburg, Germany.

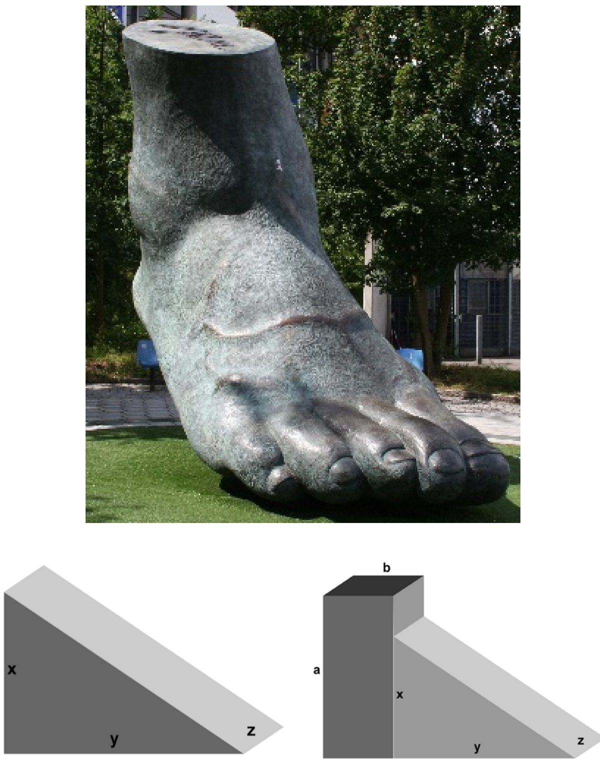

Figure 2: Fuß Uwe Seeler
(https://en.wikipedia.org/wiki/File:Fu %C3 %9F_Uwe_Seeler.JPG) and possible solutions for splitting the foot into geometric bodies (Vorhölter et al., 2019, p.8).

A newspaper, the Hamburger Abendblatt, reported that Uwe Seller's real foot fits exactly 3,980 times into the sculpture. Is it possible? Uwe Seller's shoe size is 10½.

Mathematical modelling helps students understand the world around, and it contributes to the development of different competencies and appropriate attitudes including flow (Csíkszentmihályi's, 1990, as cited in Liu, & Liljedahl, 2019). It fosters metacognitive skills, conceptual understanding, creative and innovative abilities, the socio-cultural role of mathematics, and is linked to several other competencies such as reading, communication, design, and application of problem-solving strategies, which emphasise high cognitive skills (Blum, 1994; Blum & Borromeo Ferri, 2009; English, 2010; English & Watters, 2004). From an educational perspective, the purpose of modelling can be considered as an end in itself or as a method to achieve the goal of constructing mathematical knowledge (Cai et al., 2014). The first purpose is based on the assumption that the ability to model and find solutions, for life situations, is a competence that can serve an individual in daily life and the workplace. Another purpose is achieved when an individual constructs new knowledge or reconstructs the knowledge they have already acquired when engaging in a modelling process (van den Heuvel-Panhuizen, 2003). As modelling requires the use of previously acquired mathematical knowledge in different ways, it promotes a flexible and adaptable mindset for mathematical competences. Challenging modelling problems, however, require the acquisition of new mathematical facts, skills and processes, which involves the construction of new knowledge (Cai et al., 2014). Mathematical modelling tasks enable young students to understand the importance and usefulness of mathematics for individuals as well as for society and create opportunities for students to perceive mathematics as useful and applied rather than abstract and isolated (Asempapa, 2015).

Mathematical Modelling in Elementary School

Teaching mathematical modelling is a demanding job. Teachers need to draw on several dimensions of knowledge, including but not limited to pedagogical content knowledge (Blum, 2012), knowledge of the modelling process, understanding of student background and experience, and knowledge of teaching practices that facilitate individual and group learning (Zawojewski, Lesh, & English, 2003). Besides, the open nature of many modelling activities means that teachers need to take students' ideas into account and respond to them as they emerge. At the same time, understanding of mathematical modelling as an open, exploratory and dynamic process mean that learning to involve children in mathematical modelling had to include opportunities for teachers to learn from their practice. All classroom instruction is relational work (Lampert 2010), and modelling, which involves ongoing negotiations about the meaning and importance of contexts, assumptions, representations and mathematical strategies, intensifies relational work between and among teachers and students. It was, therefore, essential to involve teachers in the process of reflecting on modelling from two perspectives: from the perspective of a student learning to model and from the perspective of a teacher teaching others to model.

Unfortunately, mathematical modelling is rarely taught in elementary school, and even less so in primary school. Until recently, mathematical modelling was often not included in the elementary school curriculum (Brown & Ikeda, 2019). However, the basics of mathematical modelling can and should begin in elementary school where children already possess the necessary competencies on which modelling can be developed (English & Watters, 2004). For instance, Albarracína and Gorgorió (2019) argue that the use of significant number estimation problems is a suitable activity for introducing mathematical modelling processes in primary school classrooms. Results show that students can become active participants in mathematical modelling activities, even if they are fifth-grade underachievers (Zubi et al., 2019). Mellone et al. (2017) investigated whether there is a relationship between Grade 5 students' situation models and the realistic nature of their answers to problems. In clearly defining modelling as the process of creating a mathematical model from a situation model, they found working in pairs and rewording then solving led to an increase in realistic responses, but for only one problem.

Traditionally mathematical modelling in elementary schools was misunderstood as solving arithmetic problems with words (tasks with words) in which concrete materials were presented that would then model the more abstract operating rules (English, 2003; Stohlmann & Albarracin, 2016). Many of the mathematical tasks used in elementary schools are word problems - applications where either the real world does not affect the problem, either there is a clear solution strategy (Tran and Dougherty 2014). In mathematical modelling, problems can be open at the beginning of the investigation. The modellers can ask different mathematical questions about a scenario, open in the middle when the modellers investigate different solution strategies and open at the end when the modellers consider how the models can or cannot be applied to other situations. The struggle with openness in modelling is a feature that conveys the idea that real-world situations do not always have a single, clear beginning, approach, or solution.

Dogan Temur (2012) stated that effective teaching of mathematics during the first grade of primary school is crucial for the formation of students' mathematical thinking. Often solving such problems is not a modelling task for students, but relies on keywords or phrases in the problem, such as times, more, less, and so on (English, 2003); for example, *Suzy saved $12. Maria saved three times more than Suzy. How much did Maria save?* Furthermore, there is often only one way of interpreting the problem, so students are forced into limited mathematical thinking. Although we do not dispute the importance of this type of tasks, they do not address enough mathematical knowledge, processes, fluency and social skills that our children in the twenty-first century need. Below, we present a task that involves mathematical modelling and is appropriate for lower grades of primary school.

Example: *Beans, beans, glorious beans*. *Beans, beans, glorious beans* is a more straightforward mathematical modelling task in which students test their knowledge of the conditions required for plant growth and use minimal mathematical calculations. This assignment, as noted by English and Watters (2004), proved to be exciting and encouraged students to participate in the joint discussion. The task was initially published by English and Watters (2004, p. 5).

> *Farmer Sprout is trying to decide which light conditions are best for growing Butter beans. To help Farmer Sprout make his decision, he went to visit the Farmers' Association who are growing climbing Butter bean plants using two different light conditions. The two light conditions being tested are:*
>
> *a) Growing Butter beans out in the full sun with no shade at all*
> *b) Growing Butter beans underneath shade-cloth.*

Table 1: Butter beans crops.

Sunlight				Shade			
Butter Bean Plants	Week 6.	Week 8.	Week 10.	Butter Bean Plants	Week 6.	Week 8.	Week 10.
Row 1	9 kg	12 kg	13 kg	**Row 1**	5 kg	9 kg	15 kg
Row 2	8 kg	11 kg	14 kg	**Row 2**	5 kg	8 kg	14 kg
Row 3	9 kg	14 kg	18 kg	**Row 3**	6 kg	9 kg	12 kg
Row 4	10 kg	11 kg	17 kg	**Row 4**	6 kg	10 kg	13 kg

Using the data above, determine which of the light conditions is suited to grow Butter beans to produce the greatest crop. In a letter to Farmer Ben Sprout, outline your recommendation of the light condition and explain how you arrived at this decision. Predict the weight of butter beans produced on week 12 for each type of light. Explain how you made your prediction so that Farmer Ben Sprout can use it for other similar situations.

(English and Watters, 2004, p. 5).

With the help of this type of assignment, students can exchange ideas about possible solutions, since a unique solution does not limit the task. They also learn to cooperate and are forced to widen perspectives to solve the task themselves; for example, some students will ask questions asking about rain, whether this will affect the yield of the beans, in which climate the farmer lives, and so on.

Example: ***The theme park.*** We list another task appropriate for students in early primary education that involves mathematical modelling, as written in Bleier-Baxter et al. (2017, p.22).

The park manager needs your help. His intern was able to fill in only a selection of the information needed. Your group will work to complete the table with missing wait times for Universal Studios Park. You will need to mathematically justify how your group has decided to fill in the table and explain your strategy clearly on chart paper. You can use pictures, words, and symbols to help you make your strategy for filling in the missing data as clear as possible for another group to follow.

Table 2: Wait times for Universal Studio Park.

Ride	Low	Moderate	Busy	Very busy
Production Central				
Despicable Me: Minion Mayhem 3D	30	50	110	155
Transformers: The Ride 3D		30		
Shrek 4D	10			
Hollywood Rip Ride Rockit	20	30	75	110
New York				
Twister: Ride It Out	5	10	15	20
Revenge of the Mummy				90
The Blues Brothers Show	10			
San Francisco				
Beetlejuice's Graveyard Revue		15		
Disaster!			35	
World Expo				
Men in Black™: Alien Attack			55	
The Simpsons Ride	15	35	60	90
Fear Factor Live		10		
Woody Woodpecker's KidZone				
Animal Actors on Location	10	15	15	20
A Day in the Park with Barney			20	
Curious George Goes to Town		20		
Woody Woodpecker's Nuthouse Coaster				45
Fievel's Playland			15	
E. T. Adventure			45	
Hollywood				
Universal Orlando's Horror Make-Up Show	10	20	30	45
Terminator 2: 3D			35	
Lucy -A Tribute	5			

> *Your group will present your strategy for filling in the missing data to the whole class. During the presentation, each member of the group should be prepared to justify the group's strategy mathematically. Our class goal is to find the best possible model for filling in an amusement park wait times. Important note: There is no one correct way to complete this task. Your task is to try to find the best possible strategy.* (Bleier-Baxter et al., 2017, p.22).

Real-world contexts are full of underlying patterns that can be represented mathematically. To successfully "see" such underlying patterns, students must be able to identify relevant quantities in the situation. Then, they must make decisions about the best way to map relationships using mathematical tools, such as diagrams, tables, graphs, flowcharts, and formulas (Bleiler-Baxter et al., 2017). In their research with the theme park task, Bleiler-Baxter et al. (2017) stated that students identified relevant quantities within the table in different ways and that their ways of seeing the table influenced how they mapped relationships. Some students focused on pairs of data in the table and identified a possible multiplicative relationship among those pairs, some concentrate on complete rows of data and identified additive relationships. Bleiler-Baxter et al. recognised that to engage students in modelling with mathematics; it is critical for teachers to value student autonomy and to select a task that represents a complicated real-world situation. Giving students the freedom to make decisions means the decisions they make may vary. It also means the teacher must be patient to let students struggle through the process of weighing pros and cons of their decisions and not to bypass the decision-making process by stepping in and making decisions for students (Bleiler-Baxter et al., 2017).

Teachers and Mathematical Modelling

Teacher training is considered necessary in achieving high-quality teaching of mathematics. A critical step in developing and promoting high-quality modelling experiences for children and youth is to understand the learning opportunities teachers need to facilitate such experiences. Modelling will not become an integral part of students' mathematical learning if their teachers are not prepared to provide classroom leadership in this area (Fulton et al., 2019). In-service training is most effective when it is sustainable, intensive and integrated into the daily work of teachers (Garet Porter, Desimone, Birman, & Yoon, 2001). It should also be student-centred (Hawley and Valli 1999, p. 137) and take into account the existing knowledge, experience and beliefs of teachers.

Regardless of the benefits that mathematical modelling brings to learning mathematics, several situations present challenges for teachers. Teachers must give up most of their traditional ways of engaging their students to achieve goals of mathematical modelling we described previously (Asempapa, 2015).

It is known that teachers (falsely) assume that a large proportion of students finds modelling difficult or challenging, and therefore teachers rarely apply modelling activities in the classroom (Asempapa, 2015; Brown, 2019; Spandaw & Zwaneveld, 2009). Even experienced and skilled teachers may not automatically transfer their knowledge of teaching mathematics to teaching mathematical modelling. Thus, teachers need a variety of experiences and support to effectively engage students in mathematical modelling (Fulton et al., 2019). Additionally, in most textbooks developed for elementary and secondary schools, less emphasis is placed on mathematical modelling activities. Teachers rarely use modelling tasks in their classrooms due to time constraints and their perception that mathematical modelling tasks are complex and demanding (Borromeo Ferri, 2010).

Example: ***Harvesting the eucalypt forest.*** To facilitate teacher's mathematical Stillman (2019, p.2) listed a task that was used in a university mathematics unit for primary pre-service teacher education students in Australia. The students had four weeks to work on the task independently outside the class. The task follows:

> *Those of you who drive the Western Freeway between Ballarat and Ballan will have noticed that a large plantation of Eucalypts has been felled and the logs transported away. Using mathematical modelling pose a problem related to the removal of the forest that can be mathematised and solved [The task was accompanied by several photographs taken before, during and after the felling of the trees.].* (Stillman, 2019, p.2.)

The purpose of mathematical modelling was to analyse an existing real-world situation (the felling of a forest) as a means of answering a practical question. Both mathematical and extra-mathematical knowledge were needed to answer this question. It is also an example of using modelling as empowerment for students to become independent users of their mathematics (Stillman, 2019). Any solution depends on particular assumptions. Different assumptions may lead to a different solution method which may not be what the teacher intended. A critical aspect of mathematical modelling is that the modeller makes decisions, for example, considering some, but not all real-world aspects in one's initial solution, describing how to interpret terms such as the best one. Such mathematical thinking naturally leads to diverse solutions, but the task must be presented in such a way as to allow this (Brown & Ikeda, 2019).

Fulton et al. (2019) identified four features of modelling practice that could be developed and used by the novice, as well as experienced modellers: a) wrestling with openness in modelling, b) posing mathematical problems to address real-world situations, c) making choices creatively while modelling and d) revisiting ideas and revising solutions during the modelling process. Fulton et al. (2019) stated that these features were unlikely to be a part of most teachers as learners' experiences in teaching and learning mathematics. Wrestling with openness in modelling is a feature that conveys the idea that real-world situations do not always have a single, clean-cut beginning, approach, or solution. Problem posing is a central feature not only of mathematical modelling, but of mathematical activity in general that can occur before, during, or after the solution of a problem. Furthermore, making choices creatively while modelling focuses on the ability to determine what mathematics the modeller will use or develop to make progress on a modelling task. Finally, revisiting ideas and solutions during the modelling process involves considering whether the solution makes sense in light of the initial problem (Fulton et al., 2019).

Slovenian school curriculum (Žakelj et al., 2011) explicitly address mathematical modelling. The curriculum also contains a topic entitled *Mathematical problems and real-life problems from first to ninth grade*. The Croatian curriculum devoted less attention to modelling; the term mathematical modelling was not mentioned in the elementary school curriculum at all. After our study, in the school year of 2019/2020, the revamped Croatian curriculum was applied, addressing modelling more explicitly (Ministarstvo znanosti obrazovanja i sporta, Hrvaška [Ministry of Science and Education Croatia], 2018).

The research aimed to examine Slovenian and Croatian teachers' self-reported knowledge on beliefs about mathematical modelling. Participants were teachers in the lower grades of public elementary schools.

Methodology

An exploratory study using a self-constructed questionnaire delivered to teachers in both countries was used. We have used the methods of quantitative empirical pedagogical research. The questions were set in Croatian for teachers from Croatia and in Slovene for teachers from Slovenia. We asked the teachers several questions addressing their knowledge and beliefs following two main research questions:

1. What are teachers' beliefs regarding mathematical modelling?
2. Are there any differences among countries?

Sample

The survey was carried out based on completed questionnaires on a convenience sample of 438 teachers from Slovenia and 449 teachers from Croatia, together 887. In Slovenia, we were interested in the knowledge of first to fifth-grade elementary teachers, because of the nine-year elementary school system of education, In Croatia, we were interested in the knowledge of first to fourth-grade elementary teachers, because of the eight-year primary school system.

Table 3: Sample structure

Country	*f*	*f* %
Slovenia	438	49.4
Croatia	449	50.6
Total	887	100

Instrument

A questionnaire was designed with several types of questions: (a) questions about teachers' basic data (gender, years of work experience in the classroom), (b) general questions about mathematical modelling, (c) claims regarding mathematical modelling given with a five-point Likert scale of agreement/disagreement, (d) questions about teachers' opinions regarding introducing mathematical modelling into the classroom.

Before conducting the survey, we did a pilot survey on 20 primary teachers in Slovenia and Croatia and adapted the questionnaire according to the results. The questionnaires we used to collect the data were online surveys. We surveyed from February 2019 to June 2019. As we collected data using an online survey, teachers from all parts of Slovenia and Croatia were represented. The obtained data were processed and analysed using the IBM SPSS statistics 22 program.

Results

In Table 4, we present the results regarding whether teachers were ever acquainted with the concept of mathematical modelling.

Table 4: Teachers' acquaintance with the concept of mathematical modelling

Are you acquainted with the concept of mathematical modelling?			
		f	*f* %
Slovenia	yes	41	9.4
	no	343	78.3
	barely	54	12.3
	total	438	100
Croatia	yes	32	7.1
	no	373	83.1
	barely	44	9.8
	total	449	100
Slovenia and Croatia	yes	73	8.2
	no	716	80.8
	barely	98	11.0
	total	887	100

The participating teachers from Slovenia and Croatia are not familiar with the concept of mathematical modelling. Only 95 (21.7 %) of Slovenian participants are acquainted or barely acquainted with the concept of mathematical modelling. Similarly, only 76 (16.9 %) of Croatian participants are acquainted or barely acquainted with this concept. A vast majority of the teachers in both countries have not heard about the term mathematical modelling. There was no difference between Slovenian and Croatian teachers regarding this question ($\chi^2 = 3.251, p = .197$). The next question regarding modelling targets teachers' experience in class. Table 5 presents the results.

Table 5: Teachers' incorporation of mathematical modelling into teaching

Do you incorporate tasks/activities that include mathematical modelling in your math class?			
		f	*f* %
Slovenia	yes	34	9.4
	no	276	75.8
	sometimes	54	14.8
	total	364	100
Croatia	yes	39	8.7
	no	344	46.6
	sometimes	66	14.7
	total	449	100
Slovenia and Croatia	yes	73	9.0
	no	620	76.2
	sometimes	120	14.8
	total	813	100

The results in Table 5 show that among Slovenian participants, 87 teachers (20.0 % of 438) include or sometimes include what they believe to be mathematical modelling in the classroom practices. Similarly, 105 (23.4 % of 449) Croatian participants' activities in their teaching include or sometimes include what they believe to be "mathematical modelling" in the classroom practices. We observed that an additional 20 teachers include mathematical modelling into classroom practice even if their answer to the first question was that they are not acquainted with mathematical modelling. There was no difference between Slovenian and Croatian participants regarding this question ($\chi^2 = 0.115, p = .944$).

When teachers completed those two general questions, we provided them with the definition of mathematical modelling by Stohlmann and Albarracin (2016). We set several statements regarding mathematical modelling, which teachers could answer. For that paper, we present the results (Table 3) for three statements.

Statement A: Mathematical modelling is an exact, formal process, or a collection of formulas and rules that have to be applied.

Statement B: Although mathematical modelling activities improve students' ability to solve problems, I find that there are too many obstacles to incorporate such activities into my math classes.

Statement C: I think mathematical modelling is a necessary skill in the 21st century for every student.

The results are presented in Table 6.

Table 6: Agreement with claims regarding mathematical modelling

		Statement A		Statement B		Statement C	
		f	*f* %	*f*	*f* %	*f*	*f* %
Slovenia	Completely disagree	40	20.8	53	27.6	2	1.1
	Partially disagree	34	17.7	39	20.3	6	3.2
	Neither agree nor disagree	45	23.4	34	17.7	21	11.1
	Partially agree	61	31.8	62	32.3	82	43.4
	Completely agree	12	6.3	4	2.1	78	41.3
Croatia	Completely disagree	71	22.3	59	18.2	6	1.9
	Partially disagree	45	14.2	57	17.6	11	3.4
	Neither agree nor disagree	100	31.4	80	24.7	35	10.9
	Partially agree	87	27.4	112	34.6	137	42.5
	Completely agree	15	4.7	16	4.9	133	41.3
Total	Completely disagree	111	21.8	112	21.7	8	1.6
	Partially disagree	79	15.5	96	18.6	17	3.3
	Neither agree nor disagree	145	28.4	114	22.1	56	11.0
	Partially agree	148	29.0	174	33.7	219	42.9
	Completely agree	27	5.3	20	3.9	211	41.3
	Total	510	100.0	516	100.0	511	100.0

Results reported in Table 6 are somewhat disappointing. Although we defined the mathematical modelling before, 73 (16.6 %) of Slovenian participants and 102 (22.7 %) of Croatian participants completely or partially agree with the statement A. That result was surprising, given the definition was written in the survey just before the statement A. It is obvious that statement A contradicts the definition. We also notice that 66 (15.0 %) of Slovenian participants and 128 (28.5 %) of Croatian participants partially agree or completely agree with statement B. However, they know that mathematical modelling improves many student capabilities, such as solving problems. 160 (36.5 %) of Slovenian participants and 260 (57.9 %) of Croatian participants partially agree or completely agree that mathematical modelling is a necessary skill for every student (statement C). The results for statement A and statement C do not differ considering the country. We applied the c^2-test (statement A: $c^2 = 5.136$, $p = .274$; statement C: $c^2 = 0.540$, $p = .969$). There are, however, significant differences regarding statement B ($c^2 = 10.763$, $p = .029$). Slovenian participants are more prone to incorporating modelling activities in teaching. Namely, almost half of the participating Slovenian teachers (47.9 %) completely or partially disagree with statement B. Slightly more than one-third of the participating Croatian teachers (35.8 %) completely or partially disagree with statement B.

The last set of questions was related to the teachers' thoughts on whether they thought they were educated enough to teach mathematical modelling in elementary math classes. Some results are shown in Table 7.

Table 7: Teachers' opinions about their professional knowledge regarding mathematical modelling

I believe that I am sufficiently educated to teach mathematical modelling in elementary math classes.			
		f	*f* %
Slovenia	Yes	43	22.6
	No	147	77.4
Croatia	Yes	85	26.4
	No	237	73.6
Total	Yes	128	25.0
	No	384	75.0
	Sum	512	100.0

As expected, most participants feel that they are not educated enough to teach mathematical modelling (75 %). Some of the reasons they mentioned in the open part of the question were: (1) insufficient workshops/education/professional training on this subject, (2) lack of examples and materials, (3) have never met this term, (4) too little experience in working with mathematical modelling, and so on. There are no significant differences among countries ($c^2 = 0.904$, $p = .342$).

Discussion and Conclusion

As the world -as well as the STEM area -progresses, we see the need for a growing number of young people who are good at connecting, constructing and modelling everyday problems. Modelling is a mathematics teaching strategy that encourages a real-world connection to the abstract world of mathematics. Mathematical models help many sciences solve their problems, which is why mathematical modelling competency is highly desirable in the modern world (Merrit et al., 2017). These are just a few of the reasons why we need mathematical modelling, and why it needs to be practised it in elementary school teaching. Our results show that more than three-quarters of lower elementary school teachers from Croatia and Slovenia have never been acquainted with the concept of mathematical modelling, one-tenth of them have barely been acquainted with mathematical modelling. The result is in line with several other studies (e.g. Stillman et al., 2013). Therefore, teacher education is crucial.

Our study detected a high rate of social desirability bias, which refers to the tendency of research subjects to give socially desirable responses instead of choosing answers that are reflective of their real feeling (Muijs, 2006). The teachers first claimed to be unfamiliar with mathematical modelling and then claimed to be introducing it into teaching (see Table 2). As we expected such a situation, we defined the term mathematical modelling. Nevertheless, teachers still provided unreasonable answers (see statement A). It seems that the questionnaire used in this study is not a sensitive instrument when examining teachers' attitudes beliefs regarding mathematical modelling. This phenomenon also occurred in several different areas of education dealing with novel approaches.

Results, reported by Lüke and Grosche (2018), for instance, show that the attitude of the organisation conducting the survey -as perceived by the participant - outperforms well-documented variables (such as sex, age, and contact to a person with a disability) in predicting the attitudes of the participant towards inclusion. Positive bias in the attitudes of participants was evident when a university surveyed them. Lüke and Grosche (2018) argued that social desirability is a neglected issue in research on attitudes towards inclusive education. Our results confirm that hypothesis in the area of mathematical modelling in education.

After describing the definition of mathematical modelling, we gave the teachers statements regarding mathematical modelling in which they could agree or disagree. In the first claim that mathematical modelling is an exact, formal process or collection of formulas and rules to be applied, more than one third (34.3 %) of the teachers partially or completely agree with the statement. However, earlier in the poll, the definition of mathematical modelling was given. There is support in the literature for the claim that teachers' beliefs appear to act as filters through which teachers interpret and ascribe meanings to their experience as they interact with children and the subject matter (Bergman Ärlebäck, 2010). Depending on the mathematical beliefs held by the teacher, it is more or less likely that they build up obstacles for introducing applications and modelling in their mathematics teaching (Bergman Ärlebäck, 2010).

Our results show that teachers agree with the importance of modelling (84.2 %). However, more than one-third of teachers (37.6 %) (partially or completely) agreed that although mathematical modelling activities improve students' ability to solve problems, there are too many obstacles to incorporate such activities into teaching maths. Students of different ages -even very young students -can learn to model, but it requires effort and investment in the sense of careful and focused teaching design, learning environments, activities and time to develop such activities and tasks (Niss, 2012).

Slovenian and Croatian teachers are aware of the fact that they are not educated enough to teach mathematical modelling (75 %) and that they need additional workshops/training, which is in line with other studies (e.g. Fulton et al., 2019). One way of providing future teachers with the necessary professional knowledge is to offer specific modelling seminars already at the university, with their own compulsory teaching experiences (Blum, 2012). We found that there were almost no significant differences between Slovenia and Croatia. These are traditionally similar school systems. In mathematics, education systems respond similarly, which has been shown in other studies from the area of mathematics education. Lipovec and Ferme (2018) report the results regarding mathematics homework practises in three countries. Slovenia, Croatia and the Slovak Republic. Even though some homework policies differ, Slovenia and Croatia are much closer to each other in homework practices than they are to the Slovak Republic. On the other hand, Sabo and Lipovec (2017) provided evidence for differences in opinions of Croatian and Slovenian teachers on the differences between curricular mathematical content.

Nevertheless, differences occurred regarding the statement B. We believe that the curricular framework in Slovenia helped Slovenian teachers shape their beliefs more accurately. In Slovenia, curricular renewal occurred in 2008, and in 2011, the documents were updated. Notably, in 2011, much attention was paid to integrating mathematics with real-world experience and applicability. In the last three years of elementary education, mathematics modelling was added as obligatory content and was also explicitly mentioned in the national mathematics curriculum (Žakelj et al., 2011).

National Educational Institute in Slovenia provided teachers with many resources. In the book *Upgrading teaching in elementary school practice* (Suban & Kmetič, 2014), the whole Chapter 4 is dedicated to mathematical modelling. Unfortunately, almost all sources focus too much on the last three years of elementary education, and mathematical modelling in Slovenia, also, has not come to life in primary school classrooms. Slovenia offers mathematical modelling materials for free-to-all users in e-textbooks (I-textbooks, 2014). The task example *Beans, beans, glorious beans,* as well as several other examples could be found in the i-textbook for fifth grade (Bajramović et al., 2014, pp. 484, 488).

The teacher plays a vital role in supporting student engagement in mathematical modelling, the reflection on it, decisions related to technology use and mathematical modelling and the interactions between these (Brown & Ikeda, 2019). We believe that it is necessary to give greater importance to the education of teachers for the implementation of mathematical modelling in teaching, and to encourage them in the introduction, work and performance of mathematical modelling tasks in the classroom. Teachers' knowledge about modelling activities can be developed through their active engagement in modelling activities. Several researchers have proposed interventions in which practising and prospective teachers engage in modelling activities as learners.

The teachers develop an understanding of the nature of mathematical modelling, of the relationship between mathematical modelling and meaningful understanding, and the nature of mathematical modelling tasks (Shahbari & Tabach, 2019). We propose increasing and developing available assignments and tasks that include mathematical modelling for elementary school. We also emphasise the need to research mathematical modelling in elementary schools, since such research is not currently available in either Slovenia or Croatia.

A more in-depth teachers' knowledge of mathematical modelling could perhaps be obtained through a similar experiment to the one conducted by English and Watters (2004) in Australia. Elementary school teachers presented four mathematical modelling tasks to their students (one of which was introduced in the introductory section of this paper) for six months, and tracked both the teachers' and their students' progress. The teachers agreed that the children enjoyed the activities, although they were perceived to be challenging. They also stated that there were substantial social gains concerning group work, social interaction, reporting and questioning skills. They considered the students at the end of the year ready to engage in more mathematically oriented tasks. They were more prepared to question assumptions and each other's interpretation of the data (English et al., 2004).

Our results show, among other things, the importance of curricular documents. In Slovenia, the curriculum contains mathematical modelling, which has shaped a more positive attitude towards the introduction of modelling into school practice. Nevertheless, the results are still disappointing, since the vast majority of teachers in Slovenia and Croatia (approximately 75 %) do not feel competent enough to teach mathematical modelling.

A crucial next step in developing and promoting quality modelling experiences for children and young people is to understand the learning opportunities that teachers need to enable such experiences. Modelling will indeed not become an integral part of students' mathematical learning if their teachers are not prepared to take the lead in this area in the classroom.

When students have opportunities to model with mathematics, they can improve their problem-solving abilities, reason mathematically, and make connections to real-world problems (Bleiler-Baxter et al., 2017). We want all students to be involved in solving real-life problems. Teachers and students should develop shared expectations for mathematical modelling in elementary school (Bahmaei, 2011). In modelling, students will face the problems that matter to them and the society in which they live. They will have to decide which information is relevant, make approximations and use appropriate mathematical tools wisely. As teams, students will persevere through challenges, and surprise us with the ways they can use mathematics to improve the world in which all of us live. Undoubtedly, we know that mathematical modelling is particularly tricky and complicated for teachers, but many studies show and point to its benefits and well-being for students. However, to achieve those goals, we first have to convince (and educate) their teachers about the importance of mathematical modelling in lower grades of elementary school.

References

Albarracín, L., & Gorgorió, N. (2019). Using large number of estimation problems in primary education classrooms to introduce mathematical modelling. *International Journal of Innovation in Science and Mathematics Education, 27*(2), 45–57.

Asempapa, R. S. (2015). Mathematical modelling: Essential for elementary and middle school students. *Journal of Mathematics Education, 1*(8), 16–29. https://doi.org/10.5951/mathteacmiddscho.21.1.0042

Bahmaei, F. (2011). Mathematical modelling in primary school, advantages and challenges. *Journal of Mathematical Modelling and Application, 9*(1), 3–13.

Bajramović, N., Repnik, A., Kociper, M., Cigula, S., Slana Mesarič, M., & Visočnik, D. (2014). *Matematika 5, i-učbenik za matematiko v 5. razredu osnovne šole* [Mathematics 5, interactive textbook for mathematics in 5th grade of elementary school]. Ljubljana: Zavod Republike Slovenije za šolstvo. [National Educational Institute Slovenia]. Retrieved February 28, 2020, from https://eucbeniki.sio.si/mat5/index.html

Bergman Ärlebäck, J. (2010). Towards understanding 'teachers' beliefs and affects about mathematical modelling, *The proceedings of CERME 6* (pp. 2096–2105). France, Lyon.

Bleiler-Baxter, S. K., Stephens, D. C., Baxter, W. A., & Barlow A. T. (2017). Modelling as a decision-making process. *Teaching children mathematics, 24*(1), 20–28.

Blum, W. (1994). Mathematical modelling in mathematics education and instruction. In T. Breiteig, I. Huntley & G. Kaiser-Messmer (Eds.), *Teaching and learning mathematics in context* (pp. 3–14). Chichester, England: Ellis Horwood Limited.

Blum, W., & Leiss, D. (2007). How do students and teachers deal with modelling problems? In *Mathematical modelling (*pp. 222-231). Woodhead Publishing.

Blum, W., Galbraith, P., Henn, H.-W., & Niss, M. (Eds.). (2007). *Modelling and applications in mathematics education*. New York, 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. Retrieved from https://pdfs.semanticscholar.org/ebc2/4e810efa2f5361b9accfc0097c2bca084b89.pdf

Blum, W. (2011). Can Modeling Be Taught and Learnt? Some Answers from Empirical Research. In G. Kaiser, W. Blum, R. Borromeo Ferri, & G. A. Stillman (Eds.), *International Perspectives on the Teaching and Learning of Mathematical Modeling, Trends in teaching and learning of mathematical modeling. ICTMA14* (pp. 15–30). Dordrecht: Springer.

Blum, W. (2012). Quality teaching of mathematical modelling: What do we know, what can we do?. In S. Cho (Ed.), *The proceedings of the 12th international congress on mathematical education* (pp. 73–96). Springer, Cham. https://doi.org/10.1007/978-3-319-12688-3_9

Borromeo Ferri, R. (2010). On the influence of mathematical thinking styles on learners' modeling behaviour. *Journal für Mathematikdidaktik* [Journal for Didactics of Mathematics], *31*(1), 99–118. https://doi.org/10.1007/s13138-010-0009-8

Brown, J. P. (2019). Real-world task context: meanings and roles. In G. Stillman & J. P. Brown (Eds.), *Lines of inquiry in mathematical modelling research in education* (pp. 53–81). Springer. https://doi.org/10.1007/978-3-030-14931-4_4

Brown J. P., & Ikeda T. (2019). Conclusions and future lines of inquiry in mathematical modelling research in education. In J. A. Stillman, J. P. Brown (Eds.), *Lines of inquiry in mathematical modelling research in education* (pp. 233–253). Springer.

Cai, J., Cirillo, M., Pelesko, J. A., Borromeo Rerri, R., Borba, M., Geiger, V., Stillman, G., English, L. D., Wake, G., Kaiser, G., & Kwon, O. N. (2014). Mathematical modeling in school education: mathematical, cognitive, curricular, instructional and teacher education perspectives. In P. Liljedahl, C. Nicol, S. Oesterle & D. Allan (Eds.), *Proceedings of the Joint Meeting of PME 38 and PME-NA 36* (pp. 145–172). Vancouver, Canada: PME-NA.

Dogan Temur, O. (2012). Analysis of prospective classroom teachers' teaching of mathematical modelling and problem solving. *Eurasia Journal of Mathematics, Science & Technology Education, 8*(2), 83–93. https://doi.org/10.12973/eurasia.2012.822a

English, L. D. (2003). *Mathematical modelling with young learners.* Retrieved February 21, 2018, from https://core.ac.uk/download/pdf/10873796.pdf

English, L. D. (2010). Young children's early modelling with data. *Mathematics Education Research Journal, 22*(2), 24–47. https://doi.org/10.1007/bf03217564

English, L. D., & Watters, J. (2004). Mathematical modelling in the early school years. *Mathematics Education Research Journal*, *16*(3), 58–79. https://doi.org/10.1007/bf03217401

English, L. D., Watters, J., & Mahoney, S. (2004) Mathematical modelling in the elementary school. *American Educational Research Association Annual meeting*, April, San Diego.

Fulton, E. W., Wickstrom, M. H., Carlson, M. A., & Burroughs, E. A. (2019). Teachers as learners: Engaging communities of learners in mathematical modelling through professional development. In G Stillman & J. P. Brown (Eds.), *Lines of inquiry in mathematical modelling research in education* (pp. 125–142). Springer. https://doi.org/10.1007/978-3-030-14931-4_7

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. American Educational Research Journal, 38(4), 915–945.

Hawley, W. D., & Valli, L. (1999). The essentials of effective professional development: A new consensus. In L. Darling-Hammond & G. Sykes (Eds.), Teaching as the learning profession (pp. 127–159). San Francisco, CA: Jossey-Bass.

I-textbooks. Spletno mesto interaktivnih učbenikov. (2014, June 10). Retrieved April 30, 2020, from https://www.iucbeniki.si/

Lampert, M. (2010). Learning teaching in, from, and for practice: What do we mean? Journal of Teacher Education, 61(1–2), 21–34.

Liu, M., & Liljedahl, P. (2019). Flow and modelling. In S. **Chamberlin** & B. **Sriraman** (Eds.), *Affect in mathematical modelling* (pp. 273–295). Springer International Publishing. https://doi.org/10.1007/978-3-030-04432-9_17

Lipovec, A., & Ferme, J. (2019). Lower elementary grades student teachers reflecting self-performed mathematical lesson. In *Book of abstracts*. Scientific Conference Research in Mathematics Education, Belgrade, May 10-11, 2019. Belgrade: Faculty of Education Zagreb.

Lipovec, A., & Ferme, J. (2018). Domaća zadaća iz matematike : utjecaj školskog i kućnog okruženja [Mathematics homework: inflence of school and home environment].*Matematika i škola [Mathematics and school],* 20(97), 51–63

Lüke, T., & Grosche, M. (2018). What do I think about inclusive education? It depends on who is asking. Experimental evidence for a social desirability bias in attitudes towards inclusion. *International Journal of Inclusive Education*, *22*(1), 38–53. https://doi.org/10.1080/13603116.2017.1348548

Mellone, M., Verschaffel, L., & Van Dooren, W. (2017). The effect of rewording and dyadic interaction on realistic reasoning in solving word problems. *Journal of Mathematical Behavior, 46*, 1–12. Merritt, J., Lee, M. Y., Rillero, P., & Kinach, B. M. (2017). Problem-based learning in K–8 mathematics and science education: A literature review. *Interdisciplinary Journal of Problem-Based Learning*, *11*(2), Article 3.

Ministarstvo znanosti i obrazovanja. [Ministry of science and education]. (2019, November 23). *Nacionalni dokument nastavnog predmeta matematika* [National document of the subject mathematics]. https://mzo.gov.hr/UserDocsImages//dokumenti/Obrazovanje/NacionalniKurikulum/PredmetniKurikulumi//Matematika %20nakon %20recenzije, %20o %C5 %BEujak %202018..pdf

Mujis, D. (2006). Measuring teacher effectiveness: Some methodological reflections. *Educational Research and Evaluation*, *12*(1), 53–74. https://doi.org/10.1080/13803610500392236

Niss, M. (2012, December). Models and modelling in mathematics education, *EMS Newsletter*, *86*, 49–51. https://www.ems-ph.org/journals/newsletter/pdf/2012-12-86.pdf

Niss, M., Galbraith, P., & Blum, W. (2007). Introduction. In W. Blum, P. L. Galbraith, H.-W. Henn & M. Niss (Eds.), *Modelling and applications in mathematics education* (pp. 3–30). New York, Springer.

Sabo, M., & Lipovec, A. (2017). Stavovi hrvatskih i slovenskih učitelja o razlikama među kurikularnim matematičkim sadržajima. [Opinions of Croatian and Slovenian teachers on the differences between curricular mathematical content]. *Matematika i škola*, [*Math and school*], *18*(89), 177–182.

Shahbari, J. A., & Tabach, M. (2019). Adopting the modelling cycle for representing prospective and practising 'teachers' interpretations of 'students' modelling activities. In J. A. Stillman & J. P. Brown (Eds.), Lines *of inquiry in mathematical modelling research in education* (pp. 179–195). Springer.

Spandaw, J., & Zwaneveld, B. (Eds.). (2009). *Modelling in 'mathematics' teachers' professional development, The proceedings of CERME 6* (pp. 2076–2085). Lyon, France.

Stillman, G. A. (2019). State of the art on modelling in mathematics education -Lines of inquiry. In J. A. Stillman & J. P. Brown (Eds.) *Lines of inquiry in mathematical modelling research in education* (pp. 1–20). Springer.

Stillman, G. A., Kaiser, G., Blum, W., & Brown, J. P. (Eds.). (2013). *Teaching mathematical modelling: Connecting to research and practice*. Springer Science & Business Media. https://doi.org/10.1007/978-94-007-6540-5

Stohlmann, M. S., & Albarracin, L. (2016). What is known about elementary grades mathematical modelling? *Education Research International*, *2016*(1), 1–9. https://doi.org/10.1155/2016/5240683

Suban, M., & Kmetič, S. (2014). *Posodobitve pouka v osnovnošolski praksi. Matematika* [Upgrading teaching in elementary school practeses. Mathematics]. Ljubljana: Zavod RS za šolstvo [National Educational Institute Slovenia].

Tran, D., & Dougherty, B. J. (2014). Authenticity of mathematical modeling. Mathematics Teacher, 107(9), 672–678.

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

Vorhölter, K., Krüger, A., & Wendt, L. (2019). Metacognition in mathematical modeling–An overview. In S. A. Chamberlin and B. Sriraman (Eds.) *Affect in Mathematical Modeling* (pp. 29–51). Springer, Cham.

Vorhölter K., Schwarz B. (2020) Fostering Students' Construction of Meaningfulness of Mathematics with Mathematical Modelling Problems. In G. Stillman, G. Kaiser and C. Lampen (Eds), *Mathematical Modelling Education and Sense-making. International Perspectives on the Teaching and Learning of Mathematical Modelling*, (pp. 323–333). Springer, Cham.

Zawojewski, J. S., Lesh, R., & English, L. (2003). A models and modelling perspectives on the role of small group learning activities. In R. A. Lesh & H. Doerr (Eds.), Beyond constructivism: Models and *modelling* perspectives on mathematics problem solving, learning, and teaching (pp. 337–358). Mahwah, NJ: Erlbaum.

Zubi, I. A., Peled, I., & Yarden, M. (2019). Modelling tasks and students with mathematical difficulties. In G. Stillman & J. P. Brown (Eds.), *Lines of inquiry in mathematical modelling research in education* (pp. 213–231). Springer. https://doi.org/10.1007/978-3-030-14931-4_12

Wendt L., Vorhölter K., Kaiser G. (2020) Teachers' Perspectives on Students' Metacognitive Strategies during Mathematical Modelling Processes– A Case Study. In G. Stillman, G. Kaiser and C. Lampen (Eds) *Mathematical Modelling Education and Sense-making. International Perspectives on the Teaching and Learning of Mathematical Modelling*, (*pp*. 335–346). Springer, Cham

Žakelj, A., Prinčič Röhler, A., Perat, Z., Lipovec, A., Vršič, V., Repovž, B., Senekovič, J., & Bregar Umek, Z. (2011). *Učni načrt. Program osnovna šola. Matematika.* [Curriculum. Compulsory education. Basic school. mathematics.]. Ljubljana: Zavod RS za šolstvo [National Educational Institute Slovenia].

Do Alternative Algorithms for Two-Digit Multiplication Really Help Students to be More Efficient?

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Abstract Standard arithmetic algorithms are the traditional part of school mathematics. The teaching and the learning of algorithms have been associated with procedures and erroneously with low-level cognition. Teaching algorithms without developing a conceptual understanding is a major concern for many mathematics teachers. However, if efficient teaching and learning strategies are used, this is not necessarily the case. Multi-digit number multiplication proved to be a difficult topic for many young students; therefore, many errors have been reported in the literature. Our research problem was to compare the efficiency of standard algorithms with the efficiency of several alternative two-digit multiplication algorithms. We designed a pedagogical experiment, after which the multiplication fluency of 5th-grade students (N = 73) was measured. Multiplication fluency was measured in two dimensions: Correctness (of the result) and time efficiency. The results show that the introduction of alternative algorithms has not hindered correctness, but the use of alternative algorithms has greatly increased the computing time. On the other hand, the results show that students consistently chose alternative algorithms, or more precisely, area algorithms. On the basis of the results obtained, some guidelines for school practice are given.

Keywords: mathematics education, elementary school, distributive property, two-digit multiplication, alternative algorithms.

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Introduction

Mathematics is defined in the syllabus (Žakelj et al., 2011) as one of the basic subjects in elementary school with numerous educational–informative, functional–formative and educational tasks. Knowledge of certain procedures, understanding, cross-curricular integration, use of mathematical knowledge and ability to solve problems are important factors for living a quality life. In the process of teaching mathematics, among other things, we raise awareness of the practical usefulness and meaningfulness of learning mathematics. The factors of quality education in elementary schools based on the principles of social responsibility are the basis for the progress of the whole society. According to *UNESCO IBE* (International Bureau of Education, n. d) raising the mathematical competence of future citizens has a positive influence on raising the GDP of the entire society.

In the initial years of elementary school, students are introduced to several types of algorithms. The most typical are the algorithms in arithmetic, which we will focus on later. Students also learn about algebraic and geometric algorithms. An example of content where we introduce algebraic algorithms are equations. In Slovenian elementary schools, the pupils are introduced to the process of solving equations in fourth grade. The first geometric constructions with the characteristics of the algorithms are also introduced to Slovenian students in fourth grade when constructing rectangles and squares.

When we talk about multiplication algorithms, we follow the definition by Jazby and Pearn, which states that multiplication algorithms are “cognitive aids that make it possible to break down a multiplication problem into a series of less cognitively demanding subroutines” (2015, p. 311). Multi-digit number multiplication is one of the more difficult concepts in early mathematics, so many of the mistakes that students make are known (for example, see Leung, 2006). On the other hand, there are few studies that deal with teaching strategies for multi-digit multiplication (Larsson, 2016). According to Fuson (2003), it is important that students have the right physical condition and a suitable learning environment in which they can successfully develop the predispositions necessary for understanding the algorithms. In addition, the algorithms must be clearly presented for an independent and successful application based on a conceptual understanding (Fan & Bokhove, 2014).

Multiplication

Multiplication is at the core of elementary arithmetic instruction and underpins other mathematical topics such as fractions, ratio, proportionality, and functions (Bakker et al., 2014). The importance of multiplication and division understanding is evident in the National Council of Teachers of Mathematics (NCTM) *Curriculum Focal Points* developed in the US (NCTM, n.d.). Multiplicative reasoning is emphasized as one of the three crucial mathematics themes (along with equivalence and computational fluency) that are interwoven through the content standards for middle grades, forming the foundation for proportional reasoning. Over-emphasizing memorization of facts or developing conceptual understanding along with factual and procedural knowledge is a long-standing problem in mathematics education (Smith, & Smith, 2006). Multi-digit multiplication can be performed through learned algorithms or student-invented strategies. Calculations concerning multiplication and division, whether learned algorithms or student-invented strategies have attracted less research when compared to addition and subtraction (Larsson, 2016). In the early 1980s, most research on calculations tended to focus on conceptual errors in algorithms, while a decade later student-invented strategies became the focus. The latter focus on student-invented strategies has prompted a number of case studies in which students have been engaged in devising methods for calculation, especially concerning multi-digit addition and subtraction (Larsson, 2016).

Multiplication can be represented in various ways, although there is less of a consensus with regard to categorizing multiplicative situations in comparison to additive situations (Fuson, 2003). Some of these representations are contextual, as in word problems or real-life problems. Multiplicative representations frequently found in the literature, include, among other situations, equal groups and rectangular arrays (Greer, 1992). In asymmetrical situations such as equal groups, the multiplier has a different role from the multiplicand. Symmetrical situations, such as rectangular arrays and area, where the two factors have the same role, are more convenient for the development of algorithms. Such multiplicative representations are not simply contextual or visual cues, they can also be perceived as the thinking tool students use when determining what actions to take with regard to the numbers in a problem or explaining properties (Yackel, 2001).

Standard Multiplication Algorithm

The place value system is the foundation of our numbering system. The efficiency of the arithmetic algorithms is based on it. A real understanding of the basic four algorithms rests on a firm grasp of the place value system. Multiplication, for example, is a little more than the combination of the place value system, distributivity, and single-digit math facts for multiplication. This combination is the mathematical reasoning that makes the multiplication algorithm work.

Students in Slovenian elementary schools are taught the standard algorithm for multiplication with one-digit numbers in fourth grade (age 9–10). The algorithm has been first presented in Slovenia in the first Slovenian schoolbook for mathematics, written by Franc Močnik and published in 1856 (Močnik, 1914).

1. Koliko je 3 krat 213 ?

```
 213      krajše 213 × 3
 213             639          3 krat 3 ednice = 9 ed.
 213                          3 krat 1 desetica = 3 des.
----                          3 krat 2 stotici = 6 stot.
 639
```

Figure 1: Močnik textbook from 1856,
reprinted for Močnik, 1914.

Learned algorithms are often referred to as vertical or standard algorithms. They typically build on the distributive property where both factors are split into ones, tens, hundreds, etc. and each part is multiplied by each part of the other factor. Implicit use of distributivity has been found to develop without instructions in elementary classrooms, focussed on student-invented strategies for multiplication. This was in contrast to commutativity, which was harder for students to discover by themselves (Ambrose et al., 2003). In fifth grade, students are introduced to the multidigit multiplication algorithm (see Figure 2).

	hundreds	tens	ones		tens	ones
	2 2	3$_{5\ 4}$	8	·	7	6
	2	6	6	0		
+		2	2	8		
	2	8	8	8		
	thousands	hundreds	tens	ones		

a)

hundreds	tens	ones		tens	ones
2 2	3$_{5\ 4}$	8	·	7	6
		2	6	6	0
	+		2	2	8
		2	8	8	8
		thousands	hundreds	tens	ones

b)

Figure 2: Slovenian standard multiplication algorithm.

We first multiply the multiplier by the highest digit of the multiplicand in two-digit multiplication with tens. Since we have multiplied with tens, we add a zero at the end of the partial product. If we have multi-digit multiplicands, we add as many zeros as the value of the most significant digit. Writing down zeros helps students to understand the final addition of partial products. We continue with the remaining digits of the multiplicand. If a partial product of digits (e.g. 7 8) results in a number that is higher than 10, ones of the partial product (6 in 56) are written off, tens of the partial product are transferred to the next place value digit. In the next step, these tens are added to the new partial product (7 3+1). In the end, we sum up two partial products. When the students understand the algorithm by reference to place values, we start by dropping the addition of zeros at the end. The algorithm takes the classic staircase shape (Figure 3, left). The staircase shape is sometimes taught directly, producing the so-called "lining up procedure" -multiply, move to the right, multiply, add. The algorithm in Slovenian schools is often illustrated with an array field (Figure 3, right).

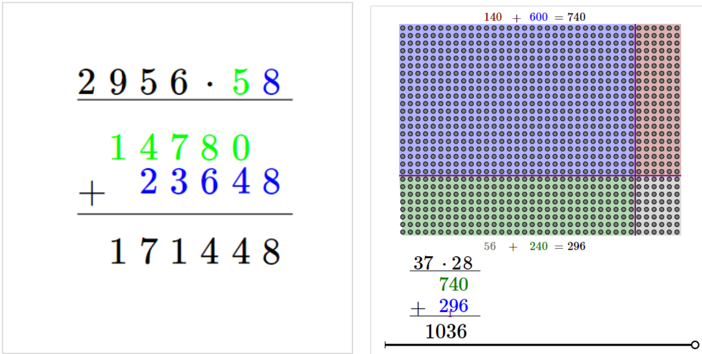


Figure 3: The »Staircase« shape of the Slovenian standard algorithm of multiplication and array model for illustration of it.

Reprinted from Bajramovič et al., 2014, p. 264, 261.

There are several "neuralgic" points for understanding this procedure. We have already mentioned the issue of "dropping" zeros. Similar is the dilemma under which of the two factors (multiplicand or multiplier) the partial product should be written. This is an important question for students who do not understand the procedure. The procedure shown in Figure 1b is mainly used in fourth and fifth grade, but since subject teachers in later grades often "drop the line" (see Figure 5), teachers in higher grades more often write the product below the multiplicand. This can be confusing for the students if it is shown without explaining the rationale.

The standard algorithm shown in Figure 2 is used in several other countries with slight changes (e.g. the spatial arrangement of the factors could be vertical instead of horizontal, see Figure 4.

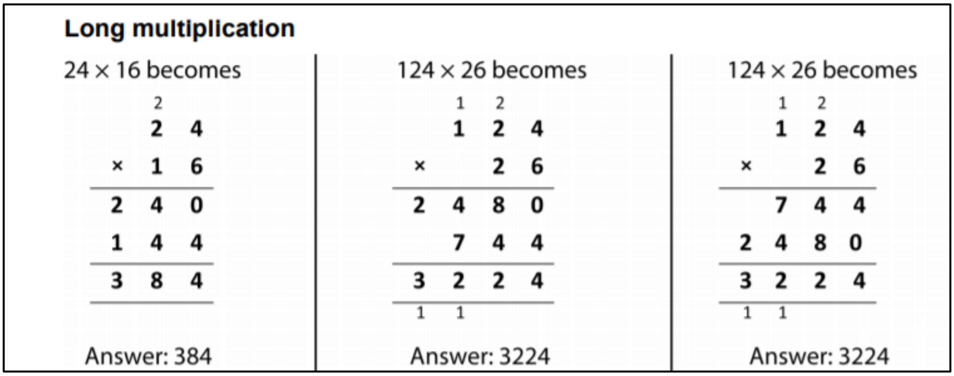


Figure 4: UK and Wales standard algorithm of multiplication.
Reprinted from Department for Education (2013, p.143)

One of the biggest advantages of a standard algorithm is its generality. It always works, the procedure is always the same, no matter what numbers we multiply, no matter what digits these numbers have, no matter how many digits we have. Ma (1999) stressed the importance of two digit by two-digit multiplication. Ma compared the lessons of Chinese and American teachers. The results show that more Chinese than American teachers are aware that two-digit multiplication occupies a particularly important place among multiplication algorithms. The multiplication of two-digit numbers is a central concept in the multiplication of multi-digit numbers. If students understand this multiplication, they will also understand other multiplication algorithms (e.g. multiplication of three-digit numbers).

In general, it is possible to figure out how to multiply any two numbers without the standard algorithm, but the strategy cannot always be generalized. Using the standard multiplication algorithm, we solve the problem of multiplication for all cases once and for all.

Another advantage is time efficiency. The record itself could be further optimized. We start by dropping zeros at the end of the partial products. Then we omit the first partial product, if the case, when the number of tens of the multiplier equals 1 (see figure 5b). Over time, we also discard small numbers that indicate how much higher place values we have gained when swapping with lower place values (e.g. 4 hundreds for 40 tens). We therefore only record what is really necessary (see Figure 5c and Figure 2a). With this, we further develop the speed of execution.

$$\begin{array}{rrrrrrr} & 3_4 & 4_4 & 5 & \cdot & 1 & 9 \\ \hline & 3 & 4 & 5 & & & \\ + & 3 & 1 & 0 & 5 & & \\ \hline & 6 & 5 & 6 & 5 & & \end{array}$$

a)

$$\begin{array}{rrrrrrr} 3_4 & 4_4 & 5 & & \cdot & 1 & 9 \\ 3 & 1 & 0 & 5 & & & \\ \hline 6 & 5 & 6 & 5 & & & \end{array}$$

b)

$$\begin{array}{rrrrrrr} 3 & 4 & 5 & & \cdot & 1 & 9 \\ 3 & 1 & 0 & 5 & & & \\ \hline 6 & 5 & 6 & 5 & & & \end{array}$$

c)

Figure 5: Dropping the line when the highest place value of the multiplier equals 1.

A multi-digit multiplication algorithm is built up from single-digit operations using the place value system and the basic properties of numbers such as distributivity. The general operations are reduced to the single-digit number facts. Regardless of students' level of understanding, students without instant recall of these foundational single-digit number facts are severely handicapped in their attempts to reach the next level of mathematics.

Several authors (e.g. Hickendorff et al., 2019; Young-Loveridge & Mills, 2009) reported that the standard algorithm for multiplication could be problematic for students. Van de Walle and colleagues (2014) pointed out that the numbers are viewed as single digits and not as decimal units. Only when adding together partial products we pay attention to how many digits the end product should have. Van de Walle and colleagues (2014) highlighted that it is very important to emphasize the importance of the digits' place value to reduce the risk of errors. When explaining the algorithm, the teacher should also create a good graphical representation of the algorithm on the blackboard (Lampert, 1986). This will help the students to better memorize spoken explanations. The graphical representation of the algorithm should be clear and transparent; the steps of the algorithm must be clearly visible.

Ma (1999) gave a more refined discussion of why rote learning might take place in the context of multi-digit multiplication: This is the case when the teacher does not possess a deep understanding of the underlying mathematics to explain it well. Teaching multi-digit multiplication using procedural methods does not give the student a proper understanding of place value and the distributive property. 70 % of teachers in the United States stated that the problem was an incorrect procedure lining up, while 30 % concluded that students did not understand the rationale of the algorithm. The teachers agreed that there is a problem with the learning comprehension for the students, which is a direct reflection of the teachers' teaching methods. Even though teachers have difficulties teaching multi-digit multiplication and notice similar errors every year when the algorithm is taught, these teachers do not seem to take steps to change teaching methods. The "carrying out the lining up" algorithm is taught with a procedurally directed method, which refers to the term "place-value" as the location of the numbers. The procedurally directed approach "verbalized the algorithm so it can be carried out correctly" yet by doing these, teachers are not providing the understanding of the importance of the definition of true place value (Ma, 1999, p. 29). Although teachers used other methods like using lined paper or a grid to position the "zeros" in the placeholder, the teacher merely suggested placing the numbers correctly. The term "place-value" was not introduced to students as a mathematical concept, but as labels for columns where they should put numbers" (Ma, 1999).

Alternative Algorithms

The advantage of working with non-standard or alternative algorithms is emphasized by many authors (e.g. Ambrose et al., 2003; Van De Walle et al., 2014). Focusing on empirically based studies, Randolph and Sherman (2001, p. 484) stated that "alternative algorithms offer a vehicle for a deeper understanding of mathematics". Fuson (2003) argued that various alternative algorithms could be suitable for multi-digit multiplication. Each of the alternatives has pros and cons and it is the teachers' job to study those pros and cons to choose the alternative algorithm. West (2011) listed nine alternative algorithms. We present three algorithms we found suitable for the fifth grade (students aged 10-11). We have to note that all the presented alternative algorithms are actually based on the same concepts as the standard algorithm, namely distributivity property $a \cdot (b + c) = a \cdot b + a \cdot c$ when decomposing multiplicands to decimal units. Alternative algorithms only represent the distributive property with a different model.

Area multiplication algorithm

The area multiplication algorithm uses "multiple representations to explain the multiplication process and can help students make connections to algebra and algebraic thinking" (West, 2011, p. 3). West (2011) presented the multiplication of $14 \cdot 12$ with an area model. First, we draw a rectangle with a height of 12 and width of 14, as we can see in Figure 6. The next step in the use of an area algorithm is to decompose the multiplicator and the multiplicand to tens and ones. Each summand is written up on one column or on the side of a row. In each sub-area, we calculate partial products of numbers that are entitled to certain sub-area. After calculating partial products, we sum them up.

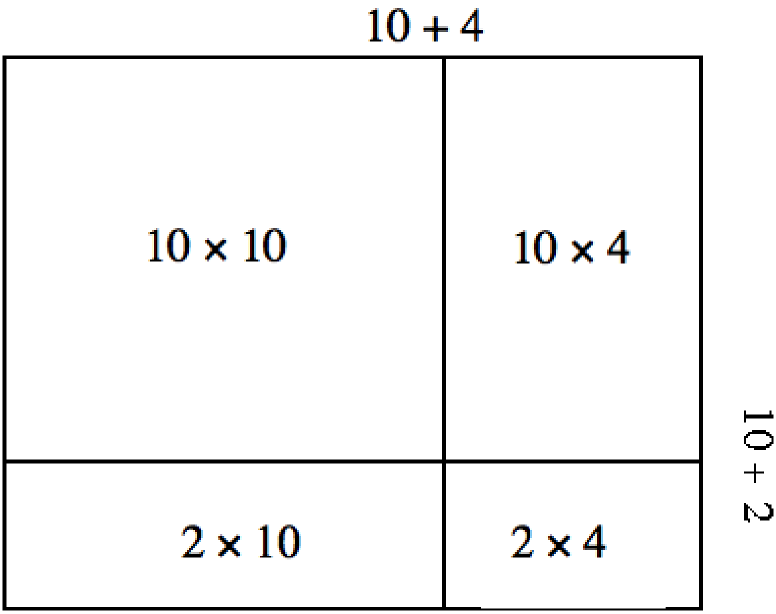


Figure 6: Area algorithm. Grid method.
Reprinted from West, 2011, p. 4.

West (2011) indicated that the area algorithm helps students to establish a fundamental understanding of a variety of basic math concepts. It can be used for calculations or only as a tool for a conceptual explanation of the standard algorithm. West (2011) also highlighted the illustration of commutative property of multiplication that can be illustrated with the area algorithm. Very similar to the area algorithm is the array-based algorithm introduced by Young-Loweridge and Mills (2009), depicted in Figure 7.

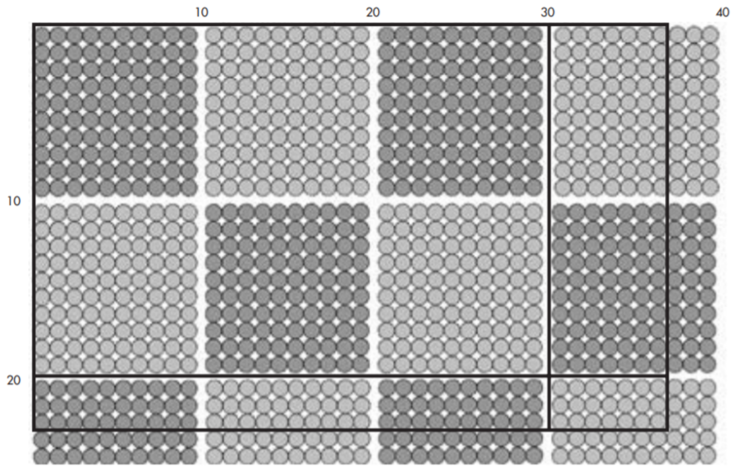


Figure 7: Area algorithm. Array model.
Reprinted from Young-Loweridge, & Mills, 2009, p. 53).

In England and Wales, the area algorithm is known as The grid method (or box method) and is often taught to pupils in primary or elementary school. It has been a standard part of the national primary school mathematics curriculum in England and Wales since the late 1990s.

Lattice multiplication algorithm

A lattice multiplication algorithm is "algorithmically identical to the traditional long multiplication method but breaks the process into smaller steps" (West, 2011). Figure 8 shows what the algorithm would look like if one wanted to multiply 453 · 25.

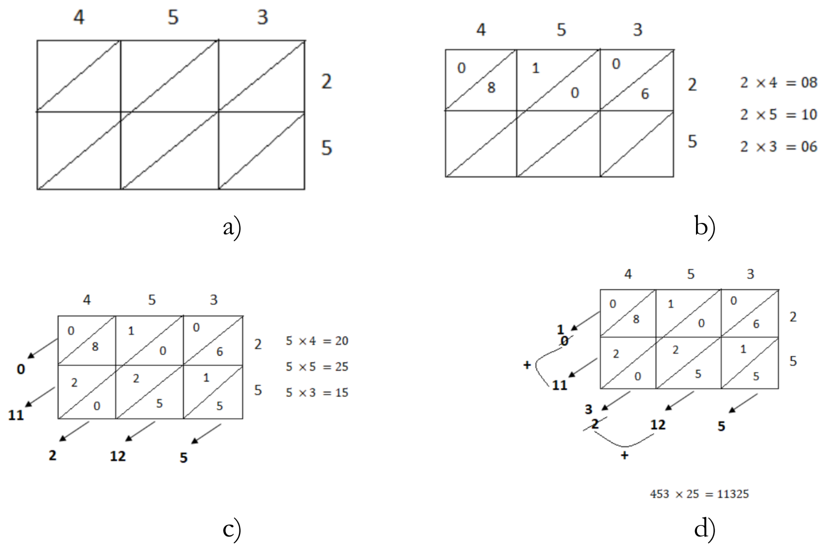


Figure 8: Lattice multiplication algorithm.
Reprinted from West, 2011, p. 5.

The area algorithm exposes decimal units of each digit in the number, lattice multiplication algorithm does not – in the first place. You still need a rectangle divided into as many columns as there are digits in the multiplier, and as many rows as there are digits in the multiplicand. We write multipliers across the top and down the right side, lining up the digits with the squares. (Figure 5a). In the case of $453 \cdot 25$, we obtain two rows, in each row, there are three squares (left, middle and right) and in each square, there are two triangles (upper and bottom). Two triangles are meant for each digit in partial products -the upper left triangle for tens and the lower right triangle for ones of the product. If the product does not have tens, then we write a zero in the upper left triangle (Figure 5b). There are two triangles for a reason -we know partial products will only have two or fewer digits.

Let us now consider where the lattice ones of the product $453 \cdot 25 = 11325$ are located. Ones in 11325 are obtained by multiplying ones of the multiplier with ones of the multiplicand $5 \cdot 3 = 15$. Therefore, ones are located in the bottom row, in the right square and in the bottom triangle (Figure 8c). Tens of the product can be obtained in three ways (Figure 8c): (a) multiplying ones of the multiplicand by tens of the multiplier (upper row, right square, bottom triangle), (b) multiplying tens of the multiplicand by ones of the multiplier (bottom row, middle square, bottom triangle) or (c) by carrying over the ones obtained in the product of multiplicand ones by multiplier ones (bottom row, right square, upper triangle). Hundreds of the product can be obtained (Figure 8c): (a) by multiplying tens of the multiplicand by tens of the multiplier (upper row, middle square, upper triangle), (b) by multiplying hundreds of the multiplicand by ones of the multiplier (bottom row, left square, upper triangle), (c) by carrying over the ones obtained in a product of multiplicand ones by multiplier tens (upper row, right square, upper triangle), or (d) by carrying over the ones obtained in a product of multiplicand tens by multiplier ones (upper row, middle square, upper triangle). Graphically that can be depicted as adding together the numbers along the diagonals (Figure 8c). If we get two-digit sums, we need to carry them to the next place and then record the final answer of multiplication (Figure 8d).

Line multiplication algorithm

Another algorithm used as an alternative is called the line multiplication algorithm. It is also a graphic representation of multiplication. We draw as many sets of vertical lines, as there are digits in the multiplier and as many sets of horizontal lines, as there are digits in the multiplicand. One set of lines represents the size of the number. For instance, if we want to multiply 22 by 13, we will draw lines like in Figure 9.

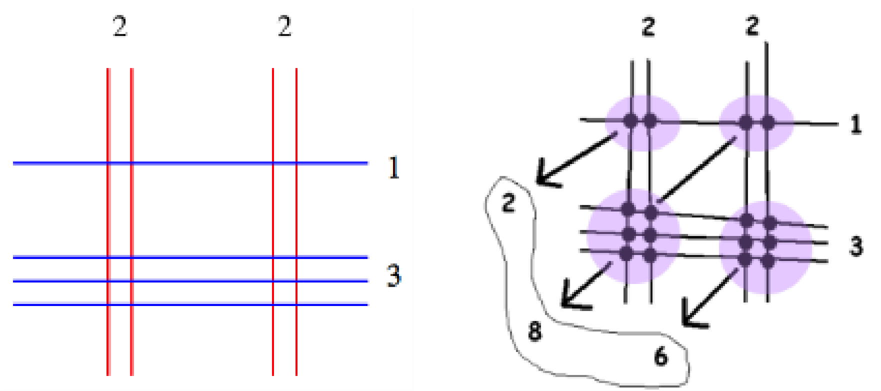


Figure 9: Line algorithm.
Reprinted from West, 2011, p. 6-7.

The next step is to highlight the intersecting points. To find the product, we count the intersecting points in each highlighted set and add diagonally. Just like with lattice multiplication, when adding diagonally we can get two-digit numbers, which means we must regroup the numbers and carry on tens to the next place (West, 2011).

The method works, because the number of parallel lines is like decimal placeholders and the number of dots at each intersection is a product of the number of lines. You are then summing up all the products that are coefficients of the same power of 10. Thus in the example shown in Figure 9: $22 \cdot 13 = (2 \cdot 10 + 2) \cdot (1 \cdot 10 + 3) = 2 \cdot 1 \cdot 10^2 + [2 \cdot 1 \cdot 10 + 3 \cdot 2 \cdot 10] + 2 \cdot 3 = 286$.

Comparing alternative algorithms

For the area algorithm of multiplication, Randolph and Sherman (2001) suggested that it improves the understanding of decimal units in multiplying two-digit numbers. You do not need any regrouping; you just multiply numbers with each other. This algorithm represent a sketch -multiplying this way helps the student to rest their brain, and it is fast and easy to calculate the product. Fuson (2003) indicated that the area algorithm of multiplication means an easier way of multiplying because it is gradual. With the lattice algorithm the teacher can identify multiplication facts for which students consistently find incorrect products. This model is divided into three main steps, which helps the student be organized and not get confused. Another benefit of the lattice algorithm is its appearance which students find appealing.

There are, of course, various disadvantages of alternative algorithms. All of them are more time consuming since you need to draw an array or a lattice or sets of parallel lines. The line multiplication algorithm is hard to use when digits are bigger since the picture becomes blurred, the problem occurs also when you multiply three-digit numbers by three-digit numbers.

Aim of the Study

While we studied different alternative algorithms, we noticed that many authors (Fuson, 2003; Jazby & Pearn, 2015; Van de Walle, 2005; West, 2011) indicate the problematics of the standard algorithm of written multiplication. The model is not easy to understand, and its use can lead to several errors, because of a lack of understanding (Leung, 2006). Therefore, we wanted to examine if any of the alternative algorithms can benefit fifth graders.

Method

A pedagogical experiment was conducted in order to answer the following question: Can teaching alternative algorithms contribute to students' two-digit multiplication fluency?

Design of the study

Students were first introduced to a standard algorithm of the two-digit multiplication. After that, some changes were applied in experimental groups. The experimental group EG1 was additionally introduced to an area algorithm, and the experimental group EG2 was additionally introduced to three alternative algorithms: an area algorithm, a lattice algorithm, and a line algorithm. During the experiment students in experimental groups did not use only the standard algorithm of two-digit multiplication, they were encouraged to use some of the alternative algorithms. The use of alternative algorithms was not mandatory, alternatives were introduced as a simple way and as a help when the standard algorithm might be too difficult to use. The experiment lasted one month (April–May 2018). After a month, we checked the participants' knowledge. Students had 45 minutes to solve the final test. On the final test, students themselves chose with which algorithm they would calculate.

Sample

We included a sample of 73 students of the fifth grade from two public elementary schools, where 55 % of students were boys. Students were divided into three groups, one control (CG) and two experimental groups (Table 1). Groups were formed according to pre-existing classes.

Table 1: Sample structure

	f	f %
Control group CG	24	33
Experimental group 1 -EG1	24	33
Experimental group 2 -EG1	25	34
together	73	100

Instrument

Data were collected with two different tests. To ensure the validity of the pedagogical experiment, we used TIMSS 2011 tasks for the fourth grade as initial testing. Examples of the TIMSS 2011 released tasks are in Figure 10. In task 28 students had to find the result of the offered products that is closest to the given product. In task 32, students needed to draw a bisector of the two-dimensional figure. Students' job in task 37 was to find the fraction that is bigger than $\frac{1}{2}$.

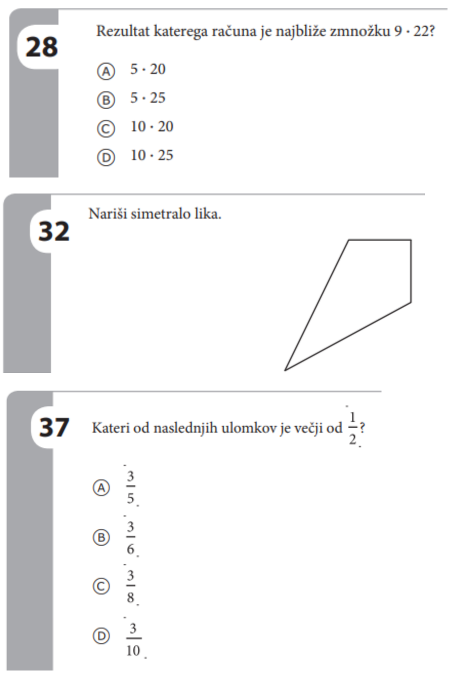


Figure 10: Some of the TIMSS 2011 tasks.

The instrument for final testing was designed for the purposes of the study and included ten numerical expressions: 12 · 53, 24 · 12, 44 · 33, 67 · 47, 27 · 35, 43 · 18, 58 · 14, 27 · 89, 94 · 29, 72 · 68. Numerical expressions were carefully chosen to represent two-digit multiplication.

Data analysis

The collected data was statistically processed in the program IDM SPSS 22. In the first part of the study, we used statistical inference to make predictions possible, and in the second part of the research, we used the Kruskal–Wallis H test to check for differences between EG1, EG2, and CG.

Results

TIMSS assignments cover different areas of mathematics and are thoughtfully created to cover different taxonomic levels. This allows us to evaluate students' previous knowledge. The results of the initial test (TIMSS) and the final test are presented in Table 2.

Table 2: Results of the initial test

		initial test results (%)	
	N	Mean (%)	Std. Dev. (%)
EG1	24	78.6	22.8
EG2	25	79.1	17.5
CG	24	82.1	20.7

Results in Table 1 show that tested groups performed similarly in both tests; inferential statistics agrees (Kruskal–Wallis $H = 0.732$, $df = 2$, $p = .693$).

The correctness of the products

Within the framework of the pedagogical experiment, alternative algorithms were adhered in the experimental group. Table 3 displays the results of the final test, regarding only correctness.

Table 3: Results of the final test

		final test results (%)	
	N	Mean (%)	Std. Dev. (%)
EG1	24	76.7	25.0
EG2	25	76.0	21.8
CG	24	80.8	25.5

We can see that the control group performed a little better in the final test as well. After introducing one alternative algorithm in EG1 and three alternative algorithms in EG2, statistical differences among students in different groups could not be confirmed (Kruskal–Wallis $H = 1.582$, $df = 2$, $p = .453$). We conclude that introducing alternative algorithms did not harm the correctness of the computational results.

Multiplication number sentences used in the final test were of different difficulties. Students' success with different number sentences is presented in Table 4. The order of number sentences is determined by the decline in CG performance.

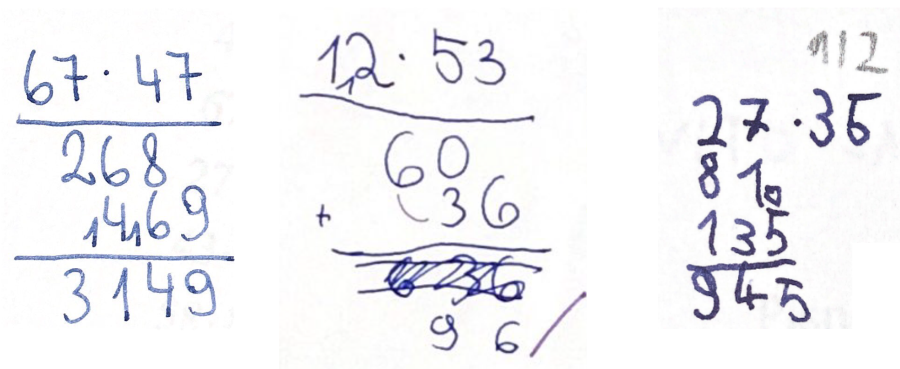
Table 4: Results regarding specific number sentences

Number sentence	EG1		EG2		CG	
	f	*f*%	*f*	*f*%	*f*	*f*%
24 · 12	21	88	23	92	21	88
94 · 29	16	67	18	72	21	88
27 · 35	20	83	18	72	21	88
43 · 18	17	70	22	88	20	83
44 · 33	19	79	16	64	20	83
12 · 35	21	88	24	96	19	79
67 · 47	18	75	16	64	19	79
72 · 68	18	75	17	68	18	75
27 · 89	16	67	15	60	15	63

The differences between groups are minimal. In some places, the difficulty of number sentences changed as students in different groups perceived it. Number sentence $12 \cdot 35$ is one such example. The number sentence is quite easy since all digits are small. The CG groups showed only 79 % success, in both experimental groups the success was much higher (88 % and 96 %). The number sentence $94 \cdot 29$ shows the opposite characteristics. In this number sentence, we have two nines as digits. The transition between places occurs when multiplying ones of the multiplicand with ones of the multiplier. The result was expected to be lower, which happened in both experimental groups (67 % and 72 %); however, the result in the control group was relatively high (88 %).

Students' strategies

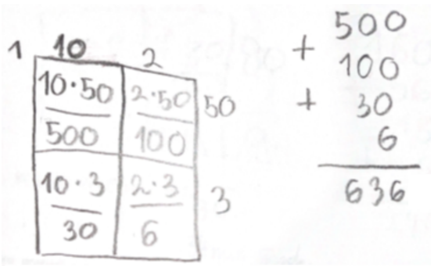
Using a standard multiplication algorithm, the students in the CG group wrote each digit of the same decimal unit one underneath the other. The majority of students did not write down the digit zero while multiplying the tens of the multiplier by the multiplier (Figure 11a). Students who used the standard algorithm in an improper manner often encountered a problem that was due to a misunderstanding of the space value. One of the examples is shown in Figure 11b. When adding together the partial products, no digit 0 was assigned to the first partial product, so the result was only shown as a two-digit. The record in Figure 11c enumeration of the digits in the multiplicand serves as help in remembering the order of the partial products. We can also observe a small digit zero.



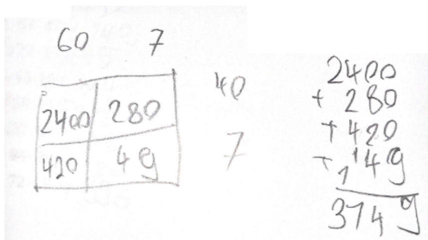
a) b) c)

Figure 11: Students' records of the standard algorithm of multiplication

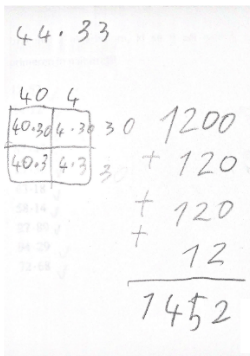
We observed at least three different strategies for the area multiplication algorithm. The first and most common is shown in Figure 12a. Students wrote down each partial calculation that belongs to a particular square. When they had all the products, they totalled the products with a written sum calculation on the side. The other strategies for using the area multiplication algorithm consisted of recording only partial products (Figure 12b) or writing down only partial number sentences without products (Figure 12c).



a)



b)



c)

Figure 12: Students' records of the area multiplication algorithm

The lattice multiplication algorithm was not used often. Using a lattice multiplication algorithm, the students first calculated partial products and then summed them. Students used arrows to depict transferring the digits to the larger decimal unit. As it can be seen in Figure 13, a student drew an arrow and wrote down which digit transfers to a larger decimal unit. This strategy helped the student to calculate the final product.

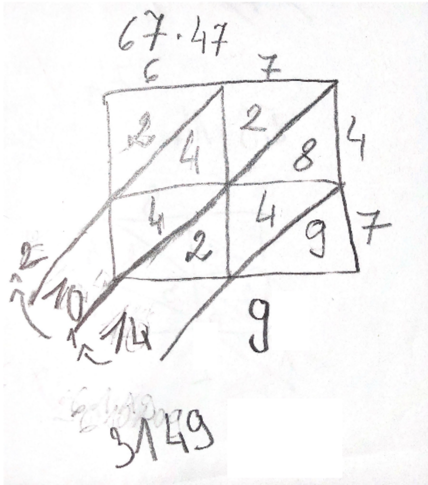


Figure 13: Students' record of the lattice multiplication algorithm

Time efficiency

Computational fluency has at least two dimensions: Correctness (of the result) and time efficiency of the calculation. Table 5 shows the average time (in minutes) taken to complete the final test, which included ten number sentences listed above.

Table 5: Time efficiency

	N	Mean (minutes)	Std. Dev.(minutes)
area	41	19.57	1.3
lattice	8	18.33	1.7
standard	24	9.23	0.5

We see that the time efficiency of the algorithm implementation is by far the best in the standard algorithm. We also noticed that the standard deviation is the lowest, which means that the standard algorithm is about equally effective for different types of learners. The differences were statistically significant (Kruskal -Wallis $H = 39.007, p = .000$) in favor of the standard algorithm.

Students from experimental groups EG1 and EG2 had an option to decide which algorithm to use on the final test – standard or any of the alternative ones. The results of student choices are presented in Table 6.

Table 6: Students who chose standard or one of the alternative algorithms.

		area		lattice		line		standard	
	N	*f*	*f* %	*f*	*f* %	*f*	*f* %	*f*	*f* %
EG1	24	24	100	0	0	0	0	0	0
EG2	25	17	71	8	29	0	0	0	0
CG	24	0	0	0	0	0	0	24	100

The results in Table 6 show that all students in EG1 and EG2 have chosen alternative algorithms. In EG2 they had four algorithms to choose from (one standard and three alternatives). The majority (71 %) chose the area algorithm, the rest chose the lattice algorithm.

Discussion and Conclusion

Kadum (2005) emphasizes the importance of understanding algorithms used by students. By deciding to introduce alternative multiplication algorithms into the learning process, we wanted to bring students closer to the understanding of the two-digit multiplication algorithm. All but three students have used algorithms in an appropriate way. Iljič (2017) exposed that students use the correct interpretation of the algorithm if their steps and understanding of the concept of the algorithm are clear and organized. The problem of the "missing zero" has also been addressed in several other studies to point out shortcomings of the standard algorithm (e.g. Hickendorff et al., 2019; Young-Loveridge & Mills, 2009). Norton (2012) pointed out that many of the students' mistakes were due to a poor understanding of the algorithms, which led to the algorithms being confused with each other (in this case the algorithm for addition and algorithm for multiplication).

There were no significant differences between the students in the control group and experimental groups in the average score in the test of written multiplication. Even in the more difficult calculations of the two-digit multiplication (comp. Table 4) the differences were not statistically significant. Students in the control group were almost three times faster in completing the final test of written multiplication. This suggests that using alternative algorithms takes more time for students than using a standard multiplication algorithm. Most students in the control group needed between 10 and 20 minutes to complete the final test. All students in the control group completed the test in less than 15 minutes.

The control group performed the final test immediately after two weeks of learning and consolidating the standard algorithm, and the experimental groups performed the final test one month after the introduction of alternative algorithms. Students were not advised which methods of written multiplication they should use. They have decided themselves whether to use the traditional algorithm or any of the alternative methods. This delay is considered as one of the limitations of the study since retention was measured only in experimental groups.

The results of our study show that the introduction of alternative algorithms does not affect the correctness in computing. The results are somehow inconsistent with some other studies (e.g. Fuson, 2003; West, 2001) which claim that the introduction of alternative algorithms is beneficial for students. It seems that the advantages lie in the conceptual part, whereas the procedural part remains unchanged.

None of the students from the experimental groups chose a standard algorithm, all of them used one of the alternative algorithms. The results indicate that students prefer alternative algorithms over the standard algorithm. Similarly, Iljič (2017) conducted research among students at a faculty, where she investigated the use of alternative algorithms of multiplication. The students were more interested in using alternative algorithms, which also led to a better understanding of the algorithm.

The area algorithm was chosen by 41 of 49 students. The results are in line with several other study findings. The area algorithm allows a process of multi-digit multiplication to be represented as a rectangle with the sides corresponding to the two factors, and this is consistent with Davis' view that "the most flexible and robust interpretation of multiplication is based on a rectangle" (2008, p. 88). Also, Young-Loweridge and Mills report in their work with 46 students (11–13 years) that the adoption of arrays representing the area (comp. Figure 3b) can be useful to improve the students' understanding of multi-digit multiplication. The students' preference for the area algorithm over the standard algorithm was also reported by Bobis (2007). In addition, Jazby and Pearn (2015) report results indicating that the use of the area multiplication algorithm is the most effective tool for explaining the standard algorithm. However, the use of alternative algorithms slowed down students in comparison to using the standard algorithm, and the average computing time was about three times shorter.

One of the basic didactic principles of arithmetic algorithms is the "delay" principle (Van de Walle et al., 2014). The first algorithm that students usually learn is the standard addition algorithm. Some students may learn standard algorithms from older relatives. However, it is highly unlikely that they will invent them themselves. Standard algorithms are therefore usually implemented by the teacher. It is also the teacher's task to make the algorithms understandable to all students. The use of algorithmic procedures in arithmetic slows down the development of the number sense, so teachers are advised to wait with the introduction of standard algorithms at least until students are able to add up to 100 fluently. When students master the standard algorithms, they quickly determine its effectiveness and use it even in situations where there is no necessity to use them, for example 999 + 1.

The results of the presented study show that students who use alternative algorithms do not achieve better computational results in multiplication than students who use a standard algorithm. However, the results also show that students prefer alternative algorithms over the standard algorithm. The area multiplication algorithm especially stands out. We agree with Van de Walle et al. (2014) that the array (also area) model promotes a visual demonstration of the commutative and distributive properties and that it can also be linked to successful representations of the standard algorithm for multiplication. The array representation of the multiplication algorithm is already present in Slovenian school practice (comp. Figure 7b). Clivaz (2017) pointed out that it is important that teachers understand the algorithm well. From our own experience, we must stress that it is very important that the teacher takes enough time to explain the algorithm to the students. It takes a little longer to explain the individual steps and their meaning, but this will reduce the time spent on consolidating the algorithm.

The importance of teaching computational algorithms, or at least the amount of time spent teaching them at school, has been frequently questioned over the past decade (Fuson, 2003). In modern society, calculations are made by technology, but man is needed to solve problems. We believe that the introduction of alternative algorithms opens up new ways to compromise between "traditional school content" represented by standard algorithms and the demand for the development of problem-solving skills represented by alternative algorithms.

References

Ambrose, R., Baek, J.-M., & Carpenter, T. P. (2003). Children's invention of multidigit multiplication and division algorithms. In A. J. Baroody & A. E. Dowker (Eds.), *The development of arithmetic concepts and skills: Constructive adaptive expertise* (pp. 305–336). Mahwah, NJ: Laurence Erlbaum.

Bajramović, N., Repnik, A., Kociper, M., Cigula, S., Slana Mesarič, M., Visočnik, D., in Visočnik, D. (2014). *Matematika 5, i-učbenik za matematiko v 5. razredu osnovne šole* [Mathematics 5, interactive textbook for mathematics in 5th grade of elementary school]. Ljubljana: Zavod Republike Slovenije za šolstvo. Retrieved December 4, 2019 from https://eucbeniki.sio.si/mat5/index.html

Bakker, M., van den Heuvel-Panhuizen, M., & Robitzsch, A. (2014). First-graders' knowledge of multiplicative reasoning before formal instruction in this domain. *Contemporary Educational Psychology, 39*(1), 59–73. https://doi.org/10.1016/j.cedpsych.2013.11.001

Bobis, J. (2007). From here to there: The path to computational fluency with multi-digit multiplication. *Australian Primary Mathematics Classroom*, *12*(4), 22–27.

Clivaz, S. (2017). Teaching multidigit multiplication: Combining multiple frameworks to analyse a class episode. *Educational Studies in Mathematics*, *96*(3), 305–325. https://doi.org/10.1007/s10649-017-9770-7

Davis, B. (2008). Is 1 a prime number? Developing teacher knowledge through concept study. *Mathematics Teaching in the Middle School*, *14*(2), 86–91.

Department for Education (2013). *The national curriculum in England: Key stages 1 and 2 framework document.* Retrieved February 22, 2020, from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/425601/PRIMARY_national_curriculum.pdf

Fan, L., & Bokhove, C. (2014). Rethinking the role of algorithms in school mathematics: A conceptual model with focus on cognitive development. *ZDM*, *46*(3), 481–492. https://doi.org/10.1007/s11858-014-0590-2

Fuson, K. (2003). Toward computational fluency in multidigit multiplication and division. *Teaching Children Mathematics, 9*(6), 300–305.

Greer, B. (1992). Multiplication and division as models of situations. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning (pp. 276–295).* New York: Macmillan.

Hickendorff, M., Torbeyns, J., & Verschaffel, L. (2019). Multi-digit addition, subtraction, multiplication, and division strategies. In A. Fritz, V. Haase & P. Räsänen (Eds.), *International Handbook of Mathematical Learning Difficulties* (pp. 543–560). Springer, Cham.

Iljić, M. (2017). *Različiti pristupi postupku množenja. Magistrske naloga.* [Different approaches to the multiplication process. Master thesis], Fakultet za odgojne i obrazovne znanosti, Sveučilište Josipa Jurja Strossmayera u Osijeku. FOOZOS Repozitorij.

International Bureau of Education (n.d.). *Economic growth and test scores on math.* Retrieved February 11, 2020, from http://www.ibe.unesco.org/en/geqaf/annexes/technical-notes/economic-growth-and-test-scores-maths

Japelj Pavešić, B. (2012). *Matematične naloge raziskave TIMSS: mednarodna raziskava trendov znanja matematike in naravoslovja* [TIMSS Mathematical tasks: Trends in International Mathematics and Science Study]. Ljubljana: Pedagoški inštitut.

Jazby, D., & Pearn, C. (2015). Using alternative multiplication algorithms to 'offload' cognition. In M. Marsham, V. Geiger & A. Bennison (Eds.), *Mathematics education in the margins (Proceedings of the 38th annual conference of the Mathematics Education Research Group of Australasia)* (pp. 309–316). Sunshine Coast: MERGA.

Juriševič, M. (2012). *Motiviranje učencev v šoli* [Motivating students in school]. Ljubljana: Pedagoška fakulteta.

Kadum, V. (2005). Utjecaj učenja rješavanjem problemskih zadataka na obrazovni učinak u elementarnoj nastavi matematike [The impact of problem solving on the educational impact of elementary mathematics teaching]. *Metodički ogledi, 12*(2), 31–60.

Larsson, K. (2016). *Students' understandings of multiplication Doctoral dissertation.* Department of Mathematics and Science Education, Stockholm University.

Lampert, M. (1986). Knowing, doing, and teaching multiplication. *Cognition and instruction*, *3*(4), 305–342.

Leung, F. K. (2006). Mathematics education in East Asia and the West: Does culture matter? In F. K. S. Leung, K.-D. Graf & F. J. Lopez-Real (Eds.), *Mathematics education in different cultural traditions: A comparative study of East Asia and the West* (pp. 21–46). New York: Springer.

Ma, L. (1999). *Knowing and teaching elementary mathematics.* Mahwah, N. J.: Lawrence Erlbaum Associates.

Močnik, F. (1914). *Računica za obče ljudske šole, izdaja v treh delih: faksimile s spremno besedo* [Workbook for general folk schools, three-part edition: Facsimiles with the accompanying word]. Ljubljana: Jutro.

National Council of Teachers of Mathematics (NCTM) (n.d.). *Curriculum focal points.* Retrieved March 1, 2020 from www.nctm.org/standards/default.aspx?id=58

Norton, S. (2012). The use of alternative algorithms in whole number computation. *International Journal for Mathematics Teaching and Learning, 26*, 2–16.

Randolph, T., & Sherman, H. (2001). Alternative algorithms: Increasing options, reducing errors. *Teaching Children Mathematics, 7*(8), 480–484.

Smith, S. Z. and Smith, M. E. (2006), Assessing elementary understanding of multiplication concepts. *School Science and Mathematics*, *106*(3), 140-149. https://doi.org/10.1111/j.1949-8594.2006.tb18171

Van De Walle, J. A., Karp, K., Bay-Williams, J. M., Wray, J. A., & Rigelman, N. R. (2014). *Elementary and middle school mathematics: Teaching developmentally (8th ed.).* Harlow: Pearson.

Yackel, E. (2001). Perspectives on arithmetic from classroom-based research in the United States of America. In J. Anghileri (Ed.), *Principles and practices in arithmetic teaching: Innovative approaches for the primary classroom* (pp. 15–31). Buckingham: Open University Press.

Young-Loveridge, J., & Mills, J. (2009). Teaching multi-digit multiplication using array-based materials. In R. Hunter, B. Bicknell & T. Burgess (Eds.), *Crossing divides: Proceedings of the 32nd annual conference of the Mathematics Education Research Group of Australasia* (pp. 635-642). Palmerston North, NZ: MERGA.

West, L. (2011). *An introduction to various multiplication strategies.* Retrieved December 6, 2019, from http://fliphtml5.com/pcnx/yiby/basic

Žakelj, A., Prinčič Röhler, Perat, Z., Lipovec, A., Vršič, V., Repovž, B., Senekovič, J., Bregar Umek, Z. (2011). *Program osnovna šola. Matematika. Učni načrt. [Elementary school program. Mathematics. Curriculum.]* Ljubljana: ZRSŠ.

Models Describing Secondary-School Students' Opinions and Attitudes Toward Mathematics

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Abstract In this research, we create some new models which additionally explain some aspects of students' motivation to learn mathematics and consequently give information about students' opinions about the mathematics taught in school. We observed a correlation between classroom experiences and mathematics contents with students' perception of general contents of mathematics. The research was conducted on the sample of 552 17-19-year-old Slovenian general upper secondary school (Gimnazija) students from the grades 3 and 4. The results show that students find general mathematics contents slightly more fascinating, attractive and exciting than boring, unattractive or unexciting, but this result correlates negatively with contents taught in school and the teaching of these contents. Our research unveils that mathematics cannot be treated as a uniform construct, but it instead consists of three more or less connected components.

Keywords: CFA, EFA, mathematics contents, mathematics teaching, SEM analysis.

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Introduction

One of the recently unearthed problems worldwide is students' lack of interest in electing STEM (Science, Technology, Engineering, Mathematics) subjects, where an election is an option; students choose enrolment into such studies at the higher educational levels (Osborne et al., 2003). In search of explanation of these trends, many expose elementary and secondary school experiences as a potential source for lack of interest, both at the content and instructional levels. It is hypothesized that students' opinions and attitudes toward STEM school subjects are a combination of students' relationship with the contents taught in that subject and the related classroom experiences, together with their satisfaction with the teacher (Šorgo et al., 2018). On the other hand, some studies have shown that students' attitudes towards secondary school science are not stable and are becoming progressively more negative over time (Abrahams, 2009; Whitley et al., 2012). Some of the recent research has shown that the quality of student-teacher relationships may play a crucial role in the upper-elementary school (Wang & Eccles, 2012; Zee et al., 2013). Teaching of mathematics is tightly connected with students' emotions (Hannula, 2006), motivation (Pajares & Graham, 1999), their attitude toward the subject (Kibrislioglu, 2015), and their self-confidence in relation to mathematics (Henderson & Rodrigues, 2008).

In our study, we used an adaptation of the STEM Semantics Scale (Tyler-Wood et al., 2010). The adaptation was first used by Šorgo et al. (2018) in a study about predictive power of school experiences with STEM subjects in choosing a career as a researcher or educator. Recently, in research about students' interest in school biology connected to the career aspirations the mention adaptation was also performed (Šorgo & Špernjak, 2020). The constructed theoretical models were created in the wake of the models from Pekrun et al. (2011).

The aim of our study was to explore connections between attitudes toward general content of mathematics, content taught at elementary and secondary schools, and related teaching practices, by application of the models proposed by Pekrun and co-workers (2011) in the framework of emotions.

We focused on the following research questions:

- Are theoretical models used by Pekrun et al. (2011) valid for our study?
- Do theoretically predicted factors form new combined factors?
- Is it possible to upgrade some of these models by reducing the number of items?
- How are factors (constructs) correlated in the models?

Based on the research questions, we formed next hypotheses:

- H1: Opinions of mathematics is a single construct.
- H2: Students' attitudes toward mathematics are formed from 5 different non-correlated constructs (general interest in mathematics, elementary school contents, secondary school contents, teaching of mathematics in elementary school, and teaching of mathematics in secondary school).
- H3: Contents in elementary school influence students' opinions about mathematics.
- H4: Teaching in secondary school has a great impact on students' opinions about mathematics.

Methods

Instrument

The questionnaire was based on a seven-point semantic scale with bipolar adjectives (Gardner, 1995). As proposed in the STEM Semantics Scale, we offered the following adjective pairs: *fascinating–boring* (F–B), *interesting–mundane* (I–M), *important–unimportant* (I–U), *attractive–unattractive* (A–U) and *exciting–unexciting* (E–U). Internal consistency and unidimensionality of each scale have already been observed by Šorgo et al. (2018). The five leading questions in the questionnaire were the following:

- I find mathematical contents (statistics, algebra, geometry, algorithms and programming, mathematical finance, optimization methods, mathematical modelling): (Q21),
- I find mathematical contents from elementary school: (Q22),
- I find mathematical contents from secondary school: (Q23),
- I find teaching mathematics from elementary school: (Q24),
- I find teaching mathematics from secondary school: (Q25).

Sample

The research was conducted on the sample of 552 secondary school students. All of the students considered in the study were in the third (59.4 %) or fourth grade (40.6 %) of the 4-year general upper secondary school, "Gimnazija", programme. Mostly, the participants were between 17 and 19 years old. The sample covered around 10 % of the complete number of Slovenian "Gimnazija" students from these two generations. More information about the Slovenian school system, the structure of the "Gimnazija" programme, and a detailed description of the sample and sampling can be found in Šorgo et al. (2018).

Statistical analyses and procedures

We used the models suggested by Pekrun et al. (2011). The first model is based on the prediction that the latent construct MATHEMATICS is unidimensional. Furthermore, the second model predicts correlation between five different latent variables MATG (general mathematics contents), MATES (elementary school mathematics contents), MATSS (secondary school mathematics contents, MATTES (teaching in elementary school) and MATTSS (teaching in secondary school) were observed. The third model additionally describes the second one and is based on the prediction that a single second-ordered construct MATHEMATICS follows from aforementioned five different constructs. To investigate the constructs' validity, we chose a two-step approach. In the first phase, we conducted an exploratory analysis (EFA) with the application of standard procedures for such types of analyses (principal component analysis with direct oblimin rotation in SPSS 24) to explore unidimensionality and reliability of the theoretically proposed factors (Field, 2013). Confirmatory factor analysis (CFA) (Schmitt, 2011) was the next step, and was carried out by AMOS 25. Due to a poor fit of the initially proposed models', procedures for their improvement were performed.

Research results

Descriptive results

Frequencies and descriptive statistics on the opinions about basic mathematics contents, mathematics contents taught in elementary and secondary school and the opinions on teaching in elementary and secondary school were considered. Table 1 shows that each construct has appropriate reliability (alpha values in the table). Skewness of observed variables (indicators) does not exceed a value of 0.8 (0.18–0.79) and the standard error of skewness is 0.14. Because of the large sample and the fact that all upper-mentioned values fall below the suggested thresholds, we might not need to be extremely concerned with the non-normal contribution when we perform SEM analysis (Lei & Lomax, 2005). Students find general mathematics contents more fascinating than boring (M = 3.60), more attractive than unattractive (M = 3.73) and more exciting than unexciting (M = 3.82). On the other hand, the majority of the means of students' opinions about school contents and teaching in elementary or secondary school are more negative than positive (see Table 1).

Table 1: Descriptive results regarding students' opinions about school contents and teaching in elementary and secondary school on a 7-point scale (N = 552)

Item		Mean	Median	Mode	Std. Deviation	Skewness
General interest in mathematics Alpha = 0.95;						
Q21a	F–B	3.60	3.00	3	1.82	0.37
Q21b	I–M	3.37	3.00	3	1.84	0.44
Q21c	I–U	3.02	3.00	1	1.85	0.68
Q21d	A–U	3.73	4.00	4	1.88	0.27
Q21e	E–U	3.82	4.00	4	1.93	0.22
Contents from elementary school Alpha = 0.95;						
Q22a	F–B	3.35	3.00	3	1.75	0.48
Q22b	I–M	3.25	3.00	2	1.80	0.51
Q22c	I–U	2.78	2.00	1	1.72	0.79
Q22d	A–U	3.42	3.00	3	1.76	0.42
Q22e	E–U	3.59	3.00	4	1.83	0.35
Contents from secondary school Alpha = 0.95;						
Q23a	F–B	3.60	3.00	2	1.80	0.37
Q23b	I–M	3.38	3.00	2	1.81	0.42
Q23c	I–U	3.21	3.00	1	1.91	0.57
Q23d	A–U	3.71	4.00	4	1.81	0.23
Q23e	E–U	3.86	4.00	3	1.84	0.18
Teaching in elementary school Alpha = 0.96;						
Q24a	F–B	3.43	3.00	3	1.76	0.42
Q24b	I–M	3.26	3.00	3	1.80	0.53
Q24c	I–U	2.95	3.00	1	1.74	0.69
Teaching in elementary school Alpha = 0.96;						
Q24d	A–U	3.44	3.00	3	1.76	0.34
Q24e	E–U	3.56	3.00	3	1.79	0.31
Teaching in secondary school Alpha = 0.96;						
Q25a	F–B	3.44	3.00	3	1.80	0.47
Q25b	I–M	3.26	3.00	1	1.88	0.56
Q25c	I–U	3.07	3.00	1	1.89	0.70
Q25d	A–U	3.56	3.00	4	1.89	0.36
Q25e	E–U	3.69	4.00	4	1.89	0.29

Note. a = *fascinating–boring* (F–B); b = *interesting – mundane* (I–M); c = *important–unimportant* (I–U); d = *attractive–unattractive* (A–U) and e = *exciting–unexciting* (E–U).

CFA of the theoretical models

Based on Pekrun et al. (2011), we first designed three different theoretical models. Model 1 assumes that every observed variable is a predictor of a single first-order variable MATHEMATICS (see Figure 1).

We can see from the model that the factor loadings for importance of contents in elementary school (0.57), importance of teaching secondary school mathematics (0.55) and also for other descriptors of students' opinions on teaching mathematics in elementary school are outstandingly low.
Model 2 was produced on five different constructs, MATG, MATES, MATSS, MATTES, and MATTSS (see Figure 2).

The model offers correlations between all created constructs. We can observe that there are still strong correlations between constructs MATES and MATTES (0.82), between constructs MATSS and MATTSS (0.86) and between constructs MATG and MATSS (0.86).

In the theoretical Model 3, a second-order latent variable MATHEMATICS was established from first-order constructs MATG, MATES, MATSS, MATTES, and MATTSS. This model shows that those latent variables (with the exception of MATES and MATTES, which have the smallest factor loadings, 0.68 and 0.59, respectively) explain the students' opinions about learning mathematics (see Figure 3).

We performed SEM analyses to explore the model fits. The construct validity of Models 1, 2 and 3 was checked by observing RMSEA (root mean square of error approximation; 0.24, 0.12, 0.13), GFI (goodness of fit index; 0.31, 0.69, 0.67), AGFI (adjusted goodness of fit; 0.18, 0.62, 0.61), CFI (comparative fit index; 0.55, 0.90, 0.88), Chisq (Chi-square; 8892.28, 2211.60, 2594.63), and *df* (degrees of freedom; 275, 265, 270), respectively. However, all three of the observed models do not fit perfectly, which can be assume from Yuan et al. (2016).

Through inspection of the models, we concluded that Model 2 showed the best fit, so we tried to improve it (see Figure 4)

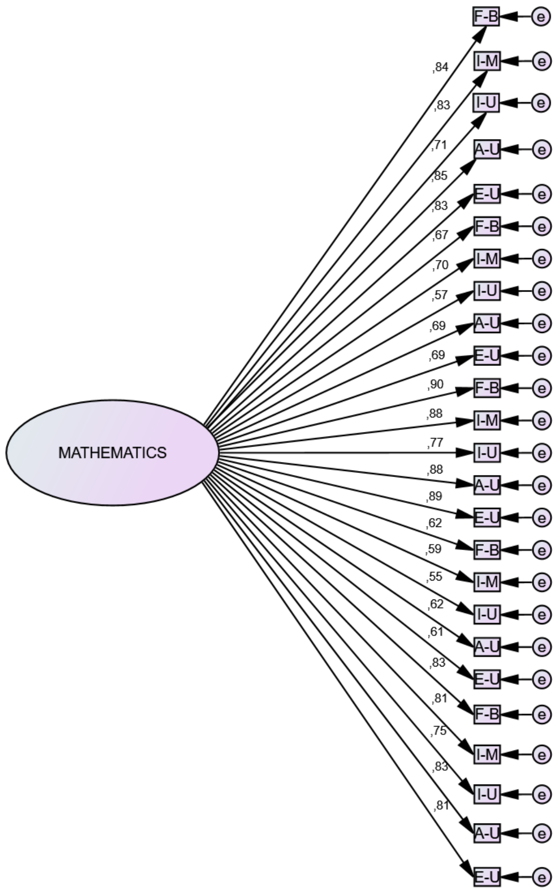

Figure 1: CFA diagram of Model 1

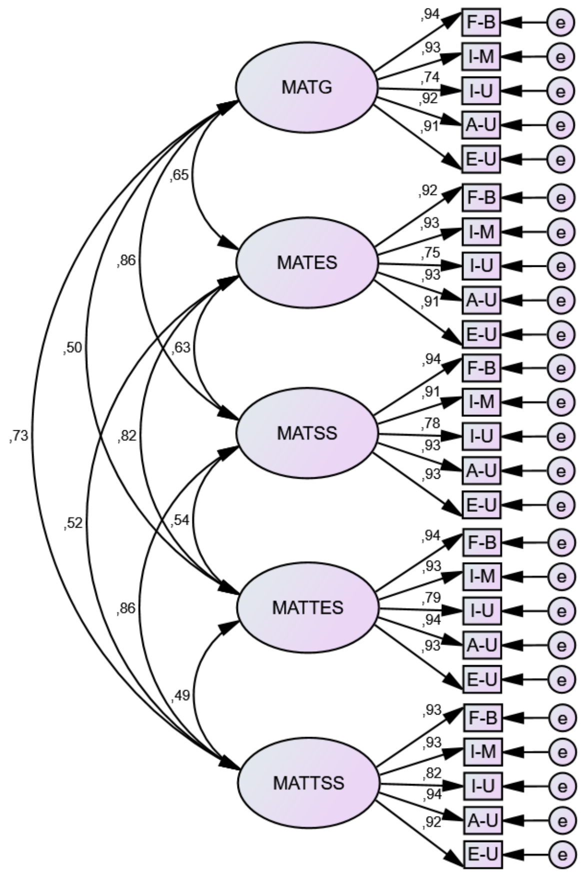

Figure 2: CFA diagram of Model 2

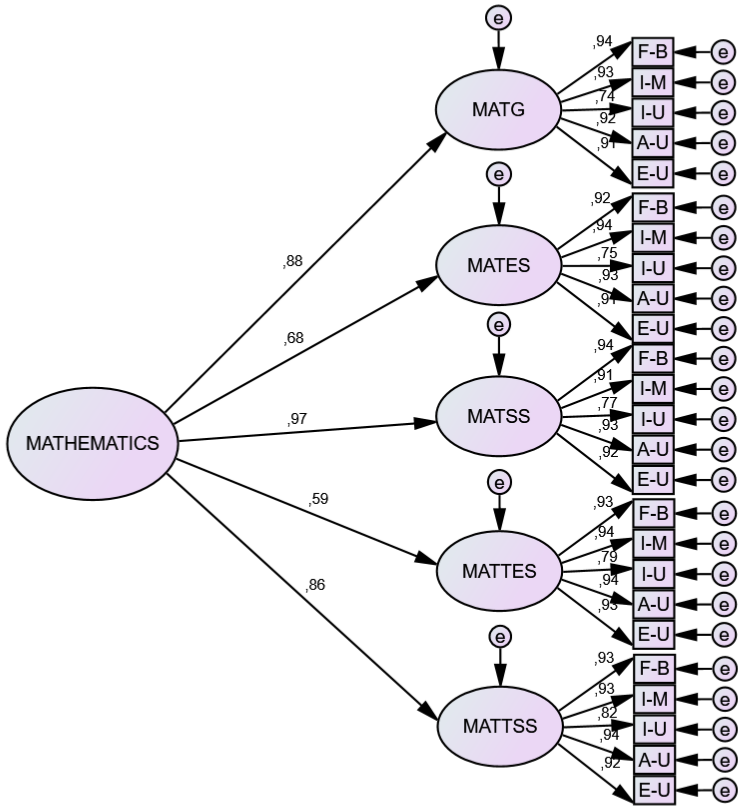

Figure 3: CFA diagram of Model 3

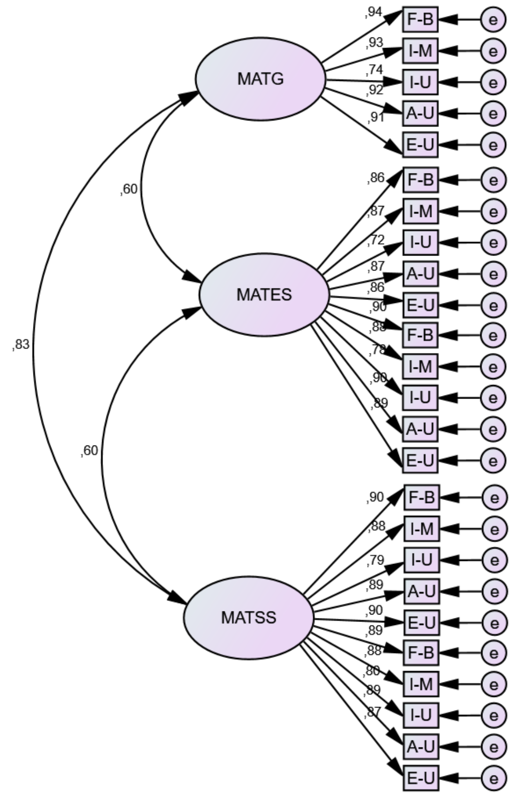

Figure 4: CFA diagram of Model 4

Principal component analysis (PCA) of the questionnaire

By performing exploratory factor analysis, more precisely, principal component analysis with direct oblimin rotation based on the eigenvalue >1 criterion, four components were identified. Sampling adequacy was checked with the Kaiser-Meyer-Olkin measure (KMO, 0.96) and sphericity (with Bartlett's test of sphericity) by $\chi^2 = 19257.31$, $df = 300$, $p < .001$.

The first factor gathered students' opinions about the secondary school mathematics (Q23a–Q23e and Q25a–Q25e). The second component represented students' opinions about the elementary school mathematics (Q22a–Q22e and Q24a–Q24e). The third component represented students' opinions on the general mathematics interest. The last, fourth factor, was formed from students' opinions about the importance of mathematics (Q21c, Q22c and Q24c).
After the application of parallel analysis (Hayton et al., 2004), only the first three factors were retained.

The explained variance of the matrix was 83.80 % when these four factors were considered, and 79.67 % when only three factors were considered. These differences are too minor to be considered as important, however; the percent is still satisfactorily high.

From the component correlation matrix in the Table 2, one can see that the third component (i.e. general mathematics interest) negatively correlates with all of the other factors, which is counter-intuitive and was regarded as quite surprising.

Table 2: Component Correlation Matrix

Component	1	2	3	4
1	1,00			
2	.43	1.00		
3	-.52	-.38	1.00	
4	.24	.22	-.15	1.00

Three-construct Model 4 based on PCA analysis

Based on the aforementioned exploratory factor analysis of our questionnaire, we created a new three-construct model with the suggested latent variables MATES, MATSS, and MATG. We tested the model and got the following fit indices:

- GFI = 0.52,
- AGFI = 0.421,
- CFI = 0.79,
- RMSEA = 0.16,
- Chisq = 4275,60,
- *df* = 272.

Poor fit indices suggested some further improvement of the model was in order. Additionally, Figure 4 shows, that the correlations between MATG and MATSS are still high, so further research was necessary.

Improved Model 4

Due to the facts from Section 3.4. and results from the PCA we modified the Model 4 to create a model with better fit indices and a smaller correlation among the factors (see Figure 5). We get the following fit indices:

- GFI = 0.91,
- AGFI = 0.86,
- CFI = 0.97,
- RMSEA = 0.082,
- Chisq = 398,23,
- *df* = 84.

From Yuan et al. (2016) one can observe that the improved Model 4 has a good fit. The adaptation of the model revealed that removing mathematics contents taught in elementary school from construct MATES and teaching of mathematics from construct, MATSS stabilizes our model.

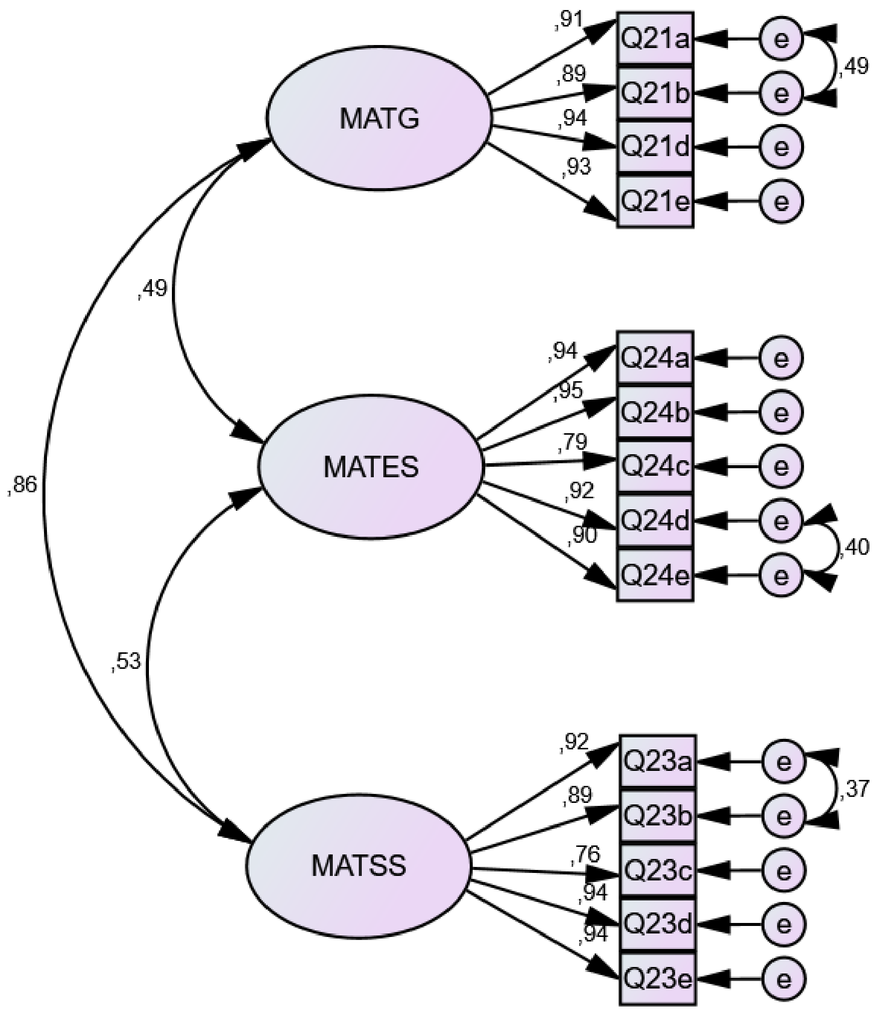

Figure 5: Improved Model 4

Importance of mathematics as a single construct

With a purpose of continuing our model research, we again studied descriptives from Table 1. The importance of mathematics stands out from the other answers (the mode of Q21c–Q25c is 1 and the mean is the lowest among all the answers). On the other hand, if we recall the results from the PCA in section 3.3., one can observe that the factor 4 was constructed from the answers Q21c, Q22c and Q24c, therefore we could use it as the independent construct. Table 3 additionally shows that in every correlation matrix answers Q21c–Q25c reach the smallest value of correlation coefficient. That is the reason for starting the exploratory factor analysis.

Table 3: Correlation matrices for each question from Q21–Q25

Correlation matrix for Q21					
	Q21a	Q21b	Q21c	Q21d	Q21e
Q21a	1.000				
Q21b	.905	1.000			
Q21c	*.682*	*.696*	1.000		
Q21d	.854	.836	*.707*	1.000	
Q21e	.852	.831	*.662*	.877	1.000
Correlation matrix for Q22					
	Q22a	Q22b	Q22c	Q22d	Q22e
Q22a	1.000				
Q22b	.878	1.000			
Q22c	.683	.728	1.000		
Q22d	.844	.867	.711	1.000	
Q22e	.836	.835	.630	.876	1.000
Correlation matrix for Q23					
	Q23a	Q23b	Q23c	Q23d	Q23e
Q23a	1.000				
Q23b	.886	1.000			
Q23c	.717	.710	1.000		
Q23d	.859	.836	.708	1.000	
Q23e	.861	.820	.704	.893	1.000
Correlation matrix for Q24					
	Q24a	Q24b	Q24c	Q24d	Q24e
Q24a	1.000				
Q24b	.896	1.000			
Q24c	*.742*	*.760*	1.000		
Q24d	.856	.869	*.738*	1.000	
Q24e	.860	.848	.703	.896	1.000
Correlation matrix for Q25					
	Q25a	Q25b	Q25c	Q25d	Q25e
Q25a	1.000				
Correlation matrix for Q25					
Q25b	.885	1.000			
Q25c	*.763*	*.777*	1.000		
Q25d	.859	.872	*.758*	1.000	
Q25e	.835	.845	*.729*	.891	1.000

We removed the answers from the primary constructs and checked if they correlate (see Table 4). As the results were satisfactory (only Q22c and Q24c for primary school slightly stand out), we formed new construct, named IMPORTANCE_OF_MATHEMATICS. The Cronbach's alpha of this new construct was 75.9 % -it passed the 70 % threshold value.

Table 4: Correlation matrix for Q21c–Q25c

	Q21c	Q22c	Q23c	Q24c	Q25c
Q21c	1.000				
Q22c	.526	1.000			
Q23c	.741	.464	1.000		
Q24c	.433	.746	.422	1.000	
Q25c	.669	.458	.807	.464	1.000

Four-construct Model 6

By application of the error terms and observing the standardized residual covariances, we obtained the four-construct Model 6 (see Figure 6). Analogously to the analysis in section 3.3., the sampling adequacy of new constructs was checked with the Kaiser-Meyer-Olkin (KMO) measure (0.801) and sphericity (with Bartlett's test of sphericity), c^2 = 1623.833, $df = 6$, $p < .001$.

We obtained the improved four-construct model with the suggested latent variables MATES, MATSS, MATG and IMPORTANCE_OF_MATHEMATICS.

We performed SEM analyses to explore the model fits. The construct validity of Model 6 was checked by observing RMSEA (0.11), GFI (0.87), AGFI (0.8), CFI (0.95), Chisq (685.53), and *df* (92).

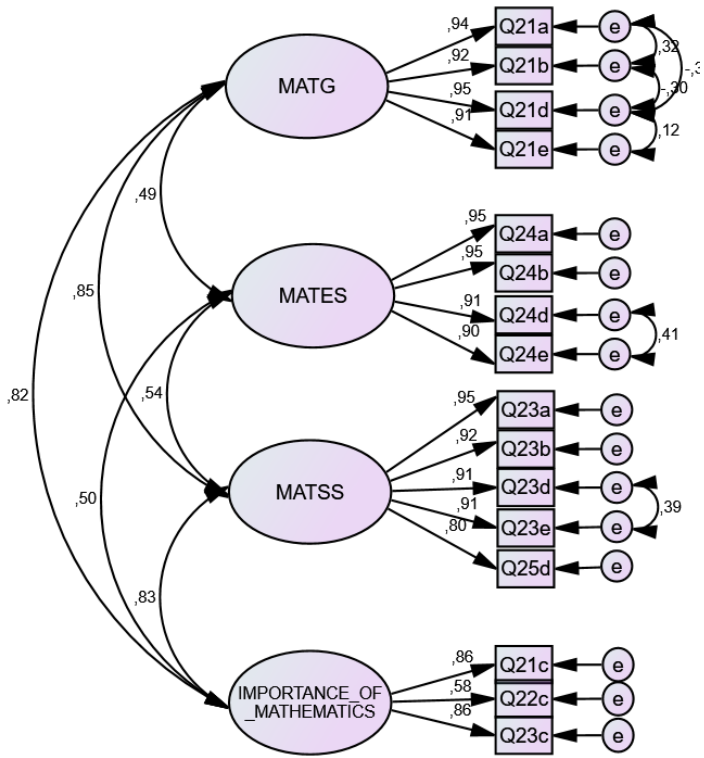

Figure 6: EFA diagram of Model 6

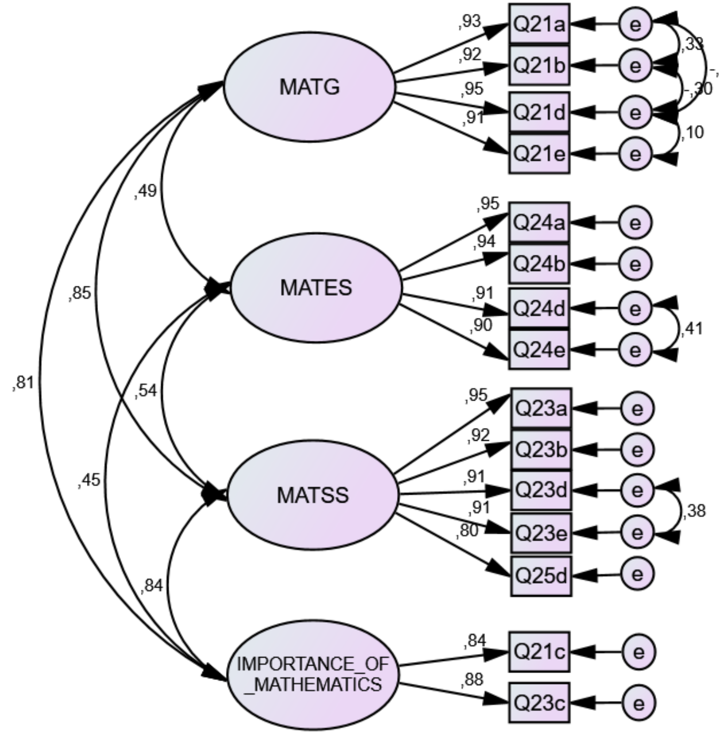

Figure 7: EFA diagram of Improved Model 6

Improved Model 6

Due to the reflection in section 3.5., the construct IMPORTANCE_OF_MATHEMATICS could be updated such that we exclude answers about the importance of contents from primary school mathematics (Q22c), which gave the smallest correlation indices (see Table 8). An exploratory factor analysis diagram of the improved Model 6 is depicted in Figure 7.

The explained variance of the matrix was 82.00 % when the new factor and factors MATG, MATES, and MATSS were used.

The following are model fits, which show that the improved Model 6 has a better fit than the afore-constructed Model 6:

- RMSEA = 0.10,
- GFI = 0.89,
- AGFI = 0.84,
- CFI = 0.96,
- Chisq = 482.81,
- *df* = 78.

Discussion and Conclusion

From the descriptives, one can observe that students' opinion about general mathematics contents is more positive than negative. On the other hand, students' opinions on the contents and teaching in elementary or secondary school are exactly the opposite. From the high correlation between theoretical constructs MATSS and MATTSS and between MATES and MATTES, we found out that these latent variables might be parts of a single construct. Therefore, we might define another model that gives us more accurate information about defining the second-latent variable MATHEMATICS. Moreover, there are still some options for further polishing of the Model 4. From the PCA results and the pattern matrix we could create one more latent variable, named "THE IMPORTANCE OF MATHEMATICS". This could be the option for further analysis.

The results from the PCA together with the descriptive statistics seem fairly interesting. The most remarkable result of the PCA is the negative correlation between students' opinions about general mathematics contents and their opinions about the contents taught in school together with the teaching. Apparently, students perceive mathematics as something more or less valuable; however, they want that it presented in school in a more attractive, important, interesting, fascinating and exciting fashion.

The improved Model 4 revealed that the contents of primary school mathematics do not influence students' perceptions about primary school mathematics, and in contrast, the teaching of mathematics in secondary school does not influence students' opinions about the secondary school mathematics. Due to the lack of the information, we could not understand these two findings and therefore we left those questions open for further study of the subject. Model 6 showed that students' opinions about mathematics could be more thoroughly observed by additional observation of their perception of the importance of mathematics as a single construct. The improved Model 6 additionally showed that we do not consider the importance of contents and teaching of elementary school mathematics when dealing with students' opinions about the importance of mathematics.

Our research unveiled that mathematics could not be treated as a uniform construct. We do not have a full explanation of the relative unimportance and unattractiveness of school mathematics. We also believe that there are such respectable mathematics teachers who insert lots of efforts to make their lessons exciting and make a great impression on students, and give them a positive attitude toward mathematics. But the results show that there is room for improvement of our secondary school teaching in such a way that the students would better recognize our efforts. Results also hint at the mathematics contents in elementary school not being attractive and important enough for students, so this again calls for further study. By changing our teaching approaches in secondary school mathematics and choosing more attractive contents in elementary school mathematics, those two indicators would play a more important role in shaping students' perceptions of mathematics.

References

Abrahams, I. (2009). Does practical work really motivate? A study of the affective value of practical work in secondary school science. *International Journal of Science Education, 31*(17), 2335–2353. https://doi.org/10.1080/09500690802342836

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Thousand Oaks, CA: Sage.

Gardner, P. L. (1995). Measuring attitudes to science: Unidimensionality and internal consistency revisited. *Research in Science Education*, *25*(3), 283–289. https://doi.org/10.1007/BF02357402

Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics*, *63*(2), 165–178. https://doi.org/10.1007/s10649-005-9019-8

Hayton, J. C., Allen, D. G., & Scarpello, V. (2004). Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. *Organizational Research Methods*, *7*(2), 191–205. https://doi.org/10.1177/1094428104263675

Henderson, S., & Rodrigues, S. (2008). Scottish student primary teachers' levels of mathematics competence and confidence for teaching mathematics: Some implications for national qualifications and initial teacher education. *Journal of Education for Teaching: International Research and Pedagogy*, *34*(2), 93 –107. https://doi.org/10.1080/02607470801979533

Kibrislioglu, N. (2015). An investigation about 6th grade students' attitudes towards mathematics. *Procedia - Social and Behavioral Sciences*, *186*, 64–69. https://doi.org/10.1016/j.sbspro.2015.04.024

Lei, M., & Lomax, R. G. (2005). The effect of varying degrees of nonnormality in structural equation modeling. *Structural Equation Modeling: : A Multidisciplinary Journal*, *12*(1), 1–27. https://doi.org/10.1207/s15328007sem1201_1

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes toward science: A review of the literature and its implications. *International Journal of Science Education*, *25* (9), 1049–1079. https://doi.org/10.1080/0950069032000032199

Pajares, F., & Graham, L. (1999). Self-efficacy, motivation constructs, and mathematics performance of entering middle school students. *Contemporary Educational Psychology*, *24*(2), 124–139. https://doi.org/10.1006/ceps.1998.0991

Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The achievement emotions questionnaire (AEQ). *Contemporary Educational Psychology*, *36*(1), 36–48. https://doi.org/10.1016/j.cedpsych.2010.10.002

Schmitt, T. A. (2011). Current methodological considerations in exploratory and confirmatory factor analysis. *Journal of Psychoeducational Assessment*, *29*(4), 304–321. https://doi.org/10.1177/0734282911406653

Šorgo, A., Dojer, B., Golob, N., Repnik, R., Repolusk, S., Pesek, I., Ploj-Virtič, M., Špernjak, A., & Špur, N. (2018). Opinions about STEM content and classroom experiences as predictors of upper secondary school students' career aspirations to become researchers or teachers. *Journal of Research in Science Teaching*, *55*(10), 1448–1468. https://doi.org/10.1002/tea.21462

Šorgo, A., & Špernjak, A. (2020). Biology content and classroom experience as predictors of career aspirations. *Journal of Baltic Science Education*, *19*(2), 317–332. https://doi.org/10.33225/jbse/20.19.317

Tyler-Wood, T., Knezek, G., & Christensen, R. (2010). Instruments for assessing interest in STEM content and careers. *Journal of Technology and Teacher Education*, *18*(2), 341–363.

Wang, M. T., & Eccles, J. S. (2012). Social support matters: Longitudinal effects of social support on three dimensions of school engagement from middle to high school. *Child Development*, *83*(3), 877–895. https://doi.org/10.1111/j.1467-8624.2012.01745.x

Whitley, A. M., Huebner, E. S., Hills, K. J., & Valois, R. F. (2012). Can students be too happy in school? The optimal level of school satisfaction. *Applied Research Quality Life*, *7*(4), 337–350.

Yuan, K. H., Chan, W., Marcoulides, G. A., & Bentler, P. M. (2016). Assessing structural equation models by equivalence testing with adjusted fit indexes. *Structural Equation Modeling: A Multidisciplinary Journal*, *23*(3), 319–330. https://doi.org/10.1080/10705511.2015.1065414

Zee, M., Koomen, H. M., & Van der Veen, I. (2013). Student-teacher relationship quality and academic adjustment in upper elementary school: the role of student personality. *Journal of School Psychology*, *51*(4), 517–533. https://doi.org/10.1016/j.jsp.2013.05.003

METHODOLOGICAL AND THEMATIC TRENDS: A CASE STUDY OF TWO PEDAGOGICAL JOURNALS IN CROATIA

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Abstract The aim of the research was to examine the methodological and thematic trends in scientific periodicals in the field of pedagogy. Two Croatian journals for education, *Život i škola* and *Napredak* in the period from 2012 to 2017, were analysed. A total of 370 articles were analysed, 143 from *Napredak* and 227 from *Život i škola*. The research results indicate that the analysed period is dominated by the topics of assessment, teacher competence, and teaching climate, while the topic of the future of education is the least represented in all segments. In methodological terms, the dominant papers are those with empirical quantitative research and categorization of original scientific and review papers. Based on the analysis of the obtained facts, the main conclusions were synthesized, and they show that the methodological and thematic trends in Croatian scientific periodicals occur with an emphasis on the dominance of the positivist paradigm, lack of historical, theoretical and futuristic research, and a small number of studies with a qualitative methodological approach.

Keywords: analysis, case study, futurology, pedagogy, research methodology, trends in education.

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Introduction

The scientific periodical of a particular field of science -branch -has been one of the most significant forms of scientific communication in the last few centuries (Kronick, 1976); it serves as a communication and correspondence device among scientists via scientific discoveries. As science developed, so did the scientific periodical. In the last few decades, information and communication technologies made a great contribution to scientific journals, which significantly accelerated and simplified scientific communication, but also created new challenges for journal publishers and editors.

In this respect, when talking about contemporary scientific journals, especially in the field of education research, there are numerous similarities, but also particularities of each journal. In addition to the particularities and similarities of the thematic and structural concepts of individual journals, some thematic trends can be seen as an indicator of the current problems that are being investigated in a given period of pedagogy, i.e. research of education. In this regard, the dominant phenomena that are being explored, current papers and authors cited, as well as the actuality of the use of certain research methods, are clearly outlined. Apart from the fact that certain research topics appeared as certain trends in research of pedagogy, the need for crystallization of specific topics addressed by individual scientific journals appeared. In other words, individual scientific journals specialize only in certain topics and works with certain types of methodology. Thus, in social sciences, there is a well-known example in psychology, the journal *Psychological Bulletin*[1] (n.d.) which publishes papers that are literature reviews (review papers) and papers with meta-analyses or journals for papers with results obtained through various qualitative methods such as *Forum Qualitative Sozialforschung* (n.d.). In the abundance of research phenomena and topics in pedagogy, certain journals specialize in specific topics, and as such, there are journals specializing only in curriculum research, for example the *Journal of Curriculum Studies* (n.d.). Certain umbrella institutions for the issue of research of education publish their journals as well: The *American Educational Research Association* (AERA, n.d.) publishes a number of relevant editorial journals such as *AERA Open, American Educational Research Journal, Educational Research, Review of Educational Research,*

[1] It should be emphasized that these journals and publishers and institutions are mentioned only for the purpose of listing examples. They are not, in any case, listed as superior journals and institutions. In addition to the mentioned journals and institutions, there are numerous quality and relevant journals and institutions for research of education.

Educational Evaluation and Policy Analysis, Journal of Educational and Behavioural Statistics, and *Review of Research in Education*. Furthermore, the crucial element of scientific journals is their indexation, their impact factor (IF), or bases in which they are indexed, such as *Current Contents, Web of Science*, and *Scopus*. The indexation in databases and IF journals essentially determines the interest of scientists in a particular journal of publication and publishing work, hence there are trends of refinement in specific scientific journals. The IF is not just a question of indexing (reputation) of a certain journal, but it can also have repercussions for further research of a particular issue. The IF is often the criterion for accepting/excluding certain scientific papers on the same or similar topic in meta-analysis. That is, the coefficient (size) of the IF of a journal in which the particular paper has been published determines whether that paper (and research results) will be accepted in the mentioned meta-analysis (Field & Gillett, 2010). This may result in a deviation of the synthesis results of such studies. That is, here we can clearly see that the recent trend of discussing the indexation bases and the IF's scientific journals is not a superficial and trendy publication, but a question of serious scientific contributions and discoveries.

Such trends show what was current in the past, and they also make it possible to predict the new research actualities of the time to come. In today's time it is necessary to reflect on, research and write about the future of one's profession (Dubovicki, 2017). Numerous sciences (Technical Sciences, Natural Sciences) have been exploring and anticipating, for many years, possible future challenges, considering possible solutions, and seeking answers. In relation to the aforementioned, we were concerned about the state of pedagogy, which should be the first field to warn about, but also answer (offer solutions) the upcoming challenges in the field of education. It is obvious that such research in the Republic of Croatia is still insufficient in continuously monitoring the content and methodological analysis of trends in the field of pedagogy with projection trends in the future. The emergence of trends in pedagogy has also been discussed at round tables in recent times (Raman, 2016)[2]. Ideas on the various innovative aspects of higher education pedagogy that would go

[2] A collection of papers on the broad theme of "Emerging Trends in Higher Education Pedagogy: Innovative Learning Environments in Higher Education" (Raman, 2016) aims to review the research done in the area of higher education pedagogy. The papers were given at a Roundtable Workshop entitled "Emerging Trends in Higher Education Pedagogy" that the School of Education, Languages and Communications organised on February 25-26, 2016, to bring together a group of experts in order to explore new forms of teaching, learning and assessment for an interactive world.

hand in hand with the contemporary understanding of education, which would successfully deal with upcoming social scenarios, have been presented.

Earlier researches (Gal et al., 1997; Haslam & McGarty, 2014) show that the selection of research methods and statistical procedures can have a stressful impact on the anxiety of students who, most often, are faced with such challenges when writing and researching for the purpose of their graduate thesis. Rock et al. (2016) take a critical approach in researching how e-learning systems could involve psychology students in research methods and statistics. We can say that this paper is another contribution of the thesis that psychology research mainly relies on quantitative methodology -research techniques by which we quantify data -and statistics as an indispensable part of the interpretation of results. The problem becomes more complicated if we consider that the phenomena of education in the research process cannot always be accurately measured or statistically "calculated".

Dubovicki et al. (2018) researched 159 graduate theses of students of Teacher Education at the Faculty of Education, University of Osijek. Of the total number, 132 (83 %) contain actual research. Furthermore, the most represented scientific field in research are social sciences (36, 47 %), and within them, pedagogy (46, 55 %). According to the type of research, empirical, fundamental, transversal and contemporary research are the predominant ones. Of all the explored scientific paradigms, the most represented is the positivist (60, 6 %), then the constructivist (17, 43 %) and post-positivist (15, 91 %) paradigm. Applied research (78 %) dominates, while developmental research (5 %) is still insufficiently represented and accepted by students. Topolovčan (2017) highlights the importance of the established theory in research of education.

Drysdale et al. (2013) conducted an analysis of doctoral dissertations and master theses in which they explored methodological and thematic trends. They noted a growth in the context of research of the combined learning. Dubovicki (2017) emphasizes that research of education rarely uses futurology methods (especially in the Republic of Croatia). Chang (2017) conducted a review of articles in four journals: *Journal of Advertising*, *Journal of Advertising Research*, *International Journal of Advertising*, and *Journal of Current Issues and Research in Advertising* from 2001 to 2015 and found that with the help of mentioned analysis it is possible to offer solutions to some methodological questions, but also to track progress and trends in research since the beginning of this century.

Bouillet and Jokić (2019) show -using abstract analyses of 2395 papers published in 265 journals indexed in *Scopus* between 1996 and 2013, in 15 countries of Central and Eastern Europe -that the specifics and dynamics of the present topics and contents throughout the above-mentioned time period in the field of education has changed over time, in terms of quantity, content and methods. These changes have resulted in more expansive and diverse research methods, whose plurality has been recognized in works published both in international and Central and Eastern Europe journals.

Previous research results of certain topics in education show that there are certain differences, accents and trends in pedagogical periodic publications on the international level. It is therefore scientifically interesting to investigate whether certain trends also exist in the Croatian pedagogical periodicals. The journals *Život i škola [Life and school] and Napredak [Progress]* are the two Croatian journals that primarily deal with publishing works from the field of education at all levels, especially pedagogical works, and are, for these reasons, worth exploring. These journals are interesting because they already contain some studies, that is, systematic analyses of their bibliographies -*Napredak* (Strugar, 2019) and *Život i škola* (Dubovicki & Munjiza, 2019; Lavrnić et al., 1982; Petrović, 1981; Subotić, 1972), which confirms their historical relentlessness for practice and science of education. Munjiza and Dubovicki (2012) follow the launch and development of *Život i škola*. Through research, they analyse, explain and interpret the contribution of *Život i škola* in the field of educational practice and pedagogical theory in the past sixty years (1952 - 2011). Following the contents of *Život i škola*, the authors followed the external and internal changes that took place in the school system in Croatia (as well as worldwide).

Methodology

Methodological trends have been described by qualitative, inferential statistics, descriptive statistics, and combined approaches to data analysis. Research is based on a case study of two Croatian educational journals. Research covered 370 papers (scientific and professional) that were published in the period from 2012 to 2017 in the two Croatian journals *Život i škola* (herein after also referred to as "ŽiŠ") and *Napredak* (herein after also "N"). The six-year period was chosen because this is the minimal time period for quality research of evolutionary trends within a time period. The analysis did not include the year, 2018 because at the time of writing, not all 2018 issues for both journals were available. In the mentioned period, there were 227 analysed papers from the journal *Život i škola*, and 143 from the journal *Napredak*. Our research covered 370 papers that were analysed according to the following parameters: year of publication, type of journal, science area, work categorization, has/does not have research, type of methodology within which the appropriate research techniques were used, used research techniques, and paper title (which determined the thematic area).

The aim of the analysis was (1) to investigate all published papers in both journals over the period from 2012 to 2017 in order to observe the pedagogical and methodological preferences of the authors, as well as the thematic trends visible from the title analysis; (2) to single out the papers that used empirical research; (3) to single out research techniques, their numeracy, and then the dominance of the qualitative/quantitative methodology; (4) to detect papers from methodology, as well as the representation of the papers of a certain categorization, whose insight is the starting point for referring the journals towards the reference bases. The purpose of the research was to identify the specifics and dynamics of the present topics and content over a certain period of time, and to develop methodological approaches in pedagogical research.

In relation to the set goals of the analysis, we start from the following research questions:

1. What is the most common categorization of papers in research journals?
2. What is the percentage of papers that use empirical research?
3. What kind of methodology prevails in papers which use research?
4. Which areas of science are most published by researchers?
5. What research technique is the most represented in works that use empirical research?
6. On average, how many research techniques do researchers use in their empirical research?
7. What is the most common topic in the field of social sciences?

Research results and interpretation

Research results will show trends during six years of research (2012-2017) of the two Croatian journals in relation to the above-mentioned criteria with which we will be able to determine the presence of trends in relation to the categorization of papers, dominance of methodology by type, representation of research techniques, scientific areas and thematic preferences.

Table 1 shows how out of 370 published papers, 79.7 % are scientific and 20.3 % are professional papers. The highest percentage (38.3 %) goes to the original scientific papers, followed by review papers (29.98 %). This information answers our research question: "What is the most common categorization of papers in research journals?"

Table 1: Categorization of research papers

Categorization	ŽiŠ*	N**	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	Sum	
	2012		2013		2014		2015		2016		2017		*f*	%
Original scientific paper	3	8	9	11	21	12	6	13	25	15	7	11	141	**38.2**
Preliminary communication	10	3	14	5	0	0	7	3	10	1	11	5	69	18.7
Review paper	10	5	13	6	0	7	9	2	22	7	2	2	85	29.98
Professional paper	13	10	8	3	0	4	12	5	6	2	8	4	75	20.3
Sum ŽiŠ	**36**		**44**		**21**		**34**		**63**		**28**		**227**	**61.4**
Sum N		**26**		**25**		**23**		**23**		**25**		**22**	**143**	**38.6**
Total sum													**370**	**100**

Looking at the comparative results for each year during six years of research, it is evident that more papers were published in *Život i škola* (61.4 %) than in *Napredak* (38.6 %). The largest number of original scientific papers was published in 2016. The reason for that might be because *Život i škola* has one extra issue, so the number of papers published in that year reflects the above-mentioned situation. As an illustration, we can state vivid examples of the ratio between professional and scientific papers in *Život i škola* (Munjiza & Dubovicki, 2012). The ratio between professional and scientific papers in 1994 was 80.4 %: 19.6 %, and in 2006, 29.4 %: 70.6 %.

The next criterion according to which the analysis was conducted was the observation of papers that have/do not have empirical research[3]. Table 2 shows that in 63.8 % of the papers empirical research is present, which is certainly important for determining the state, but also for providing opportunities for improvement. The stated result answers our next research question: "What is the percentage of papers that use empirical research?"

Table 2: Has/does not have empirical research

	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	Sum	
	2012		2013		2014		2015		2016		2017		*f*	%
It has empirical research	12	15	29	19	16	13	22	17	37	16	21	19	236	**63.8**
It does not have empirical research	24	11	15	6	5	10	12	6	26	9	7	3	134	36.2
Sum	**36**	**26**	**44**	**25**	**21**	**23**	**34**	**23**	**63**	**25**	**28**	**22**	**370**	**100**

[3] It should be emphasized that the research papers in pedagogy and didactics include theoretical, empirical and historical research (Poljak, 1991). But, in this case, for the purposes of this analysis, special emphasis has been put on empirical research

Considering the years, we can say that the number of papers that use research has increased with the years, so a similar situation is expected in the future. For the next criterion, type of methodology, we divided the papers according to whether it uses qualitative or quantitative methodology research techniques, that belong to both types of methodology, and we named that category combined. The combined methodology can be found under the name mixed methodology (Bamattre et al., 2019). In the qualitative type of methodology, we included papers which used, in the research part, the following research techniques: interview, systematic observation, paperwork analysis (textbooks, pedagogical documentation, analysis of notes, comparison of programs), qualitative futurology research methods, formative evaluation (analysis of evaluation sheets) and case analysis. Regarding the quantitative methodology, we focused on the following research techniques: survey, evaluation and assessment (various scales), test and sociometric procedures. In the category of combined methodology, there were papers that used at least one research method from both methodologies, as well as the papers in which the methodological part was done and presented via action research.

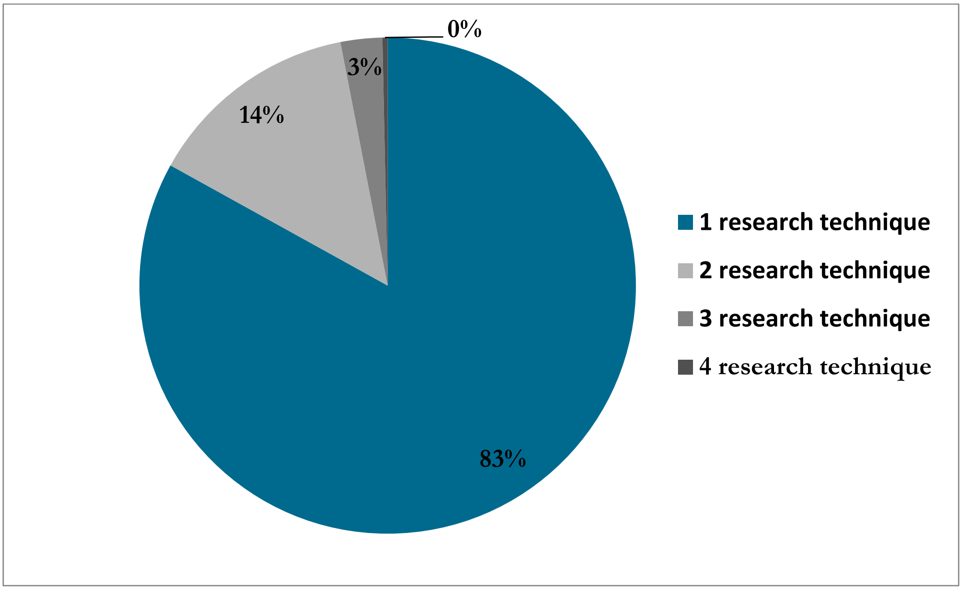
Table 3 shows the dominance of papers using quantitative methodology (72.9 %), while the category of approaches to research with the help of a combined methodology -which we consider to be most desirable in pedagogical phenomena research -is the least and insufficiently represented with only 9.7 %. That also answers our next research question: "What kind of methodology prevails in papers which use research?" Nowadays, combined or mixed methodology is considered to be the most desirable in the research of pedagogical phenomena (Ivankova & Plano Clark, 2018).

Table 3: Type of methodology

Methodology	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	Sum	
	2012		2013		2014		2015		2016		2017		*f*	%
Quantitative	**8**	**13**	**17**	**15**	**10**	**13**	**15**	**14**	**29**	**10**	**16**	**12**	**172**	**72.9**
Qualitative	2	1	6	3	3	0	5	3	4	5	4	5	41	**17.4**
Combined/Mixed	2	1	6	1	3	0	2	0	4	1	1	2	23	**9.7**
Sum	**12**	**15**	**29**	**19**	**16**	**13**	**22**	**17**	**37**	**16**	**21**	**19**	**236**	**100**

The observed situation in the researched papers with a percentage of the quantitative methodology of 72.9 % again reminds us of the dominance of the "detection" of a state (Dubovicki et al., 2018), but also the subjectivity in the research contributing to the use of one research technique (83 %) and domination of one type of methodology (72.9 %8) see Graph 1 and Table 3). The obtained results answer the following research question*:* “How many research techniques do researchers mostly use in their empirical research?”

More recently, researchers (McChesney & Aldridge, 2019) discussed a more flexible approach to the scientific paradigm and types of methodology, considering the desirable positioning of researchers in favour of the flexible (but intentional) integration of any research method within any research paradigm.



Graph 1: Presence of research techniques in the researched papers

We believe that in the research of the pedagogical phenomena it would be best to use the triangulation procedure (Bekhet & Zauszniewski, 2012; Honorene, 2016; Leech & Onwuegbuzie, 2007; Oliver-Hoyo & Allen, 2006), which would allow the researcher a more comprehensive approach to the research problem, and achieve a more accurate and valid evaluation of qualitative results. In addition to the above, more representative results would be obtained by combining qualitative and quantitative research methods, which -through their advantages and disadvantages - mutually complement each other and add to a research. Aside from the review of the current state, these research methods also provide more specific explanations and ideas for solving the mentioned state. Table 4 gives us insight into all the research techniques used during the six-year period in both journals.

Table 4: The presence of research techniques in research papers (236)

	ŽiŠ	**N**	**ŽiŠ**	**N**	**ŽiŠ**	**N**	**ŽiŠ**	**N**	**ŽiŠ**	**N**	**ŽiŠ**	**N**	**Sum**	
	2012		**2013**		**2014**		**2015**		**2016**		**2017**		***f***	**%**
Survey	6	10	16	10	7	5	8	7	21	3	15	10	**118**	**40**
Assessment scale	6	3	6	8	8	8	8	7	13	8	0	0	**75**	**25.5**
Test	1	2	4	2	2	1	4	3	5	2	0	3	**29**	**9.8**
Paperwork	2	0	3	4	2	0	4	1	5	3	3	2	**29**	**9.8**
Interview	1	1	5	0	3	0	2	2	1	5	0	2	**22**	**7.6**
Systematic observation	1	1	6	0	2	0	1	1	2	0	0	0	**14**	**4.7**
Futurology methods	0	0	0	0	0	0	0	0	0	0	1	1	**2**	**0.6**
Evaluation forms	0	0	0	0	1	0	0	0	1	0	0	0	**2**	**0.6**
Action research	0	0	0	0	0	0	0	0	0	0	1	1	**2**	**0.6**
Sociometry	0	0	0	0	0	0	1	0	0	0	0	0	**1**	**0.4**
Case study	0	0	0	0	0	0	0	0	0	0	0	1	**1**	**0.4**
Sum	17	17	**40**	24	25	14	28	21	**48**	21	20	20	**295**	**100**
%	11.5		**21.7**		13.2		16.6		**23.4**		13.6		**100**	

The most dominant research technique is the survey, by as much as 40 %, and it is followed by other research techniques belonging to the quantitative methodology: assessment scale (25.5 %) and test (9.8 %). The given data answers the following research question: "What research technique is the most represented in works that use empirical research?" When it comes to qualitative methodology, the most dominant is the analysis of documentation (9.8 %) which includes textbooks analysis, paperwork analysis, analyses of curricula, programs and so on. Research conducted by Dubovicki et al. (2018) also shows that the students of Teacher Education most often use the aforementioned research technique in their graduate theses-the survey, up to 60.6 %. Bearing in mind that the authors of the research are mainly university professors (most of them from Croatian universities), we can hereby draw the link and say that students partially "copy"their professors or their research, according to their suggestions; their methodological preferences are outlined in their papers. The analysis that matches our research in the time period of 2015 until 2017 goes hand in hand with the mentioned connection.

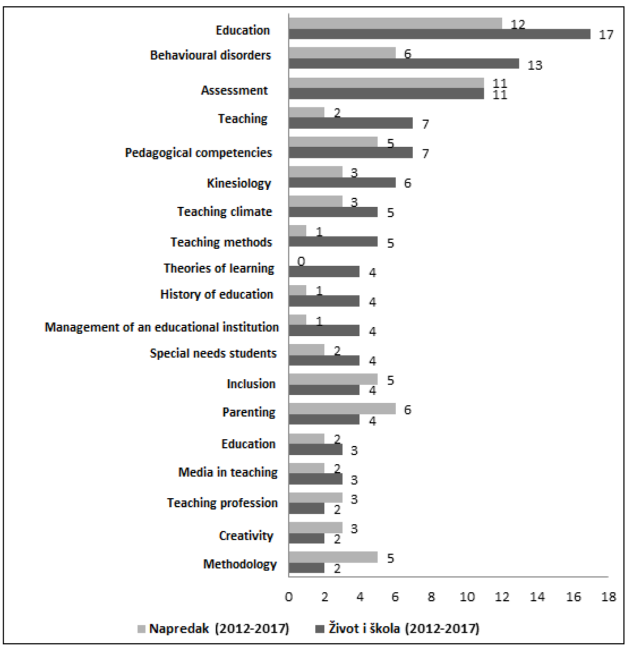
The following criterion for analysing the papers was their representation in certain scientific areas. Table 5 shows us the state over the years.

Table 5: Analysis by scientific areas

	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	ŽiŠ	N	Sum	
	2012		2013		2014		2015		2016		2017		*f*	%
Social Sciences	16	14	27	18	21	14	18	16	41	16	18	8	**227**	**61.4**
Field of Art	1	0	7	1	0	5	5	0	11	4	1	4	**39**	**10.5**
Interdisciplinary Areas of Knowledge	7	6	3	1	0	3	4	1	6	2	1	2	**36**	**9.7**
Humanistic Sciences	10	2	2	2	0	1	3	3	1	0	5	3	**32**	**8.6**
Natural Sciences	1	3	3	3	0	0	3	1	2	3	2	3	**24**	**6.5**
Technical Sciences	0	0	2	0	0	0	1	2	1	0	1	1	**8**	**2.2**
Religious sciences	1	1	0	0	0	0	0	0	1	0	0	1	**4**	**1.1**
Sum	**36**	**26**	**44**	**25**	**21**	**23**	**34**	**23**	**63**	**25**	**28**	**22**	**370**	**100**

Table 5 shows the most dominant scientific area during the six-year analysis - the area of social sciences (61.4 %), which was expected since both researched journals are on *Hrčak*[4] listed into the social areas, the field of pedagogy. The field of social sciences has been continuously the most represented in all the years in both journals, which also answers our next research question: "Which areas of science are most published by researchers?" Second place goes to all the papers published in the art field (10.5 %), seeing that from the whole number, 25 papers have been published in the journal *Život i škola*. Compared with the papers from the art field, Topolovčan (2016) stresses the importance of the qualitative approach especially in research that is artistically based. Such research is part of a recent methodological strategy that by further development, improvement, and expansion can be relevant to research of social and human sciences.

The last criterion based on which the analysis was made relates to the representation of certain thematic areas (Graph 2).



Graph 2: Analysis of papers in the field of social sciences

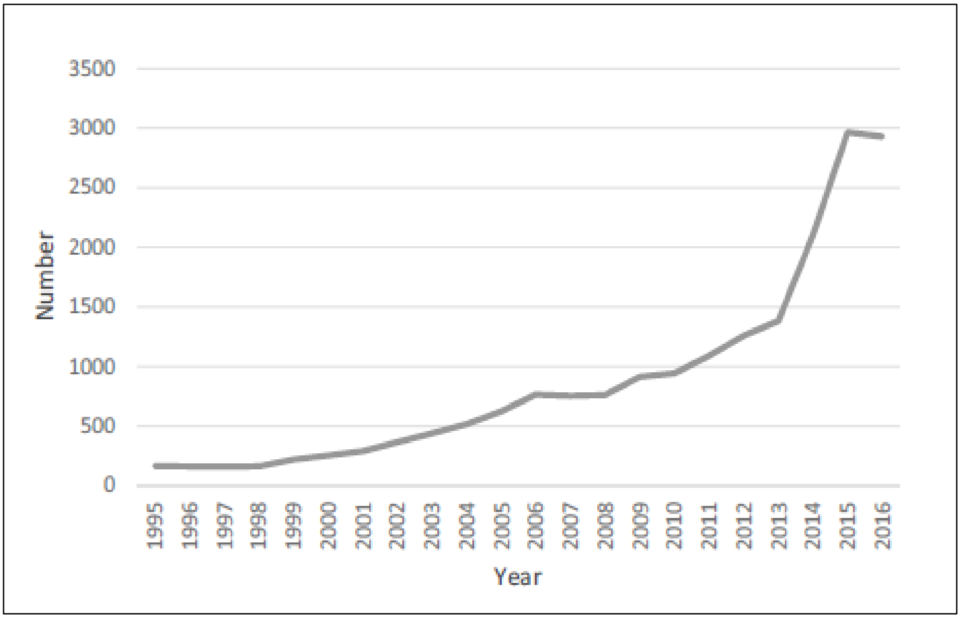
[4] *Hrčak* - a portal of Croatian scientific and professional journals, retrieved May 13, 2019, from https://hrcak.srce.hr/

Graph 2 shows a comparative analysis from which it is apparent that the subject of education is (as expected) the most represented, followed by papers dealing with assessment and behavioural disorders, which also answers the following research question: "What is the most common topic in the field of social sciences?" *Napredak* publishes more papers dealing with the topic of parenting, inclusion and methodology, while the journal *Život i škola* focuses mostly on the topics regarding teaching, pedagogical competences and kinesiology.

Discussion and Conclusion

Based on the obtained results, their interpretation and comparison with the results of some recent research on this topic, we can point to several facts. Namely, it is apparent that the journal *Život i škola* has published more papers than the journal *Napredak* in the mentioned six-year period. Furthermore, no matter which journal has the majority of published papers, the predominant ones are the scientific papers with the dominant categorization of the original scientific work. The most original scientific papers were published in 2016. This information may also be the result of publishing one extra issue of the journal *Život i škola* that year, which could have affected the final number of papers.

Globally speaking, we can say that the categorization of papers varies from year to year, but there has been a decrease of professional papers during the six-year period. One of the reasons for this situation may be the attempt of the two journals to get as close as possible to the potential databases that are valued for advancement, and which are conditioned by a smaller number of professional and a larger number of scientific papers. Furthermore, the analysis has shown that the number of papers has increased over the years (the total in both journals). Empirical research with quantitative methodology is the predominant type of research in the papers. In other words, in the field of social research, which is thematically most closely related to pedagogy, the quantitative methodology prevails. The obtained results imply that, in pedagogy, the application of quantitative methodology is still dominant, while things change dramatically in some other fields of social sciences. For comparison, psychology is a field of interest. Specifically, intriguing data were reported by the *American Psychologist* (Kazak, 2018) saying that the number of words in the headlines or keywords of articles (based on *PsycNET*) increased drastically over twenty years (Figure 1). That is, with just over 200 articles per year including the word qualitative (in the title or keywords) in 1995, just under 3000 articles (which include the word qualitative) came up. This represents almost a fifteenfold increase over a 20-year period, or an increase of over 1000 %. It indicates that in some other fields of social sciences, such as psychology, qualitative methodology is beginning to take a more prominent place as a research approach.



Picture 1: Qualitative in title or keywords in PsycNET 1995-2016
(source: Kazak, 2018, p. 2)

In comparison with other social fields of science, we believe that an approach to pedagogical research which only delivers quantification of data with the need of most often (in 83 %) just one research technique, is something that should be avoided in scientific research because we cannot generalize such results or apply them globally to similar problems.

Compared to papers published over the period from 2012 to 2017, it is evident that the trends changed in line with the changes that (directly and/or indirectly) affected our educational system at all levels of education. In addition to the prominent trends, there is a continuous presence of the topics of assessment, teacher competence and teaching climate. The subject that is the least represented in all segments deals with the reflections on the future of education. It should also be pointed out that the analysed journals published no papers with meta-analyses, complex qualitative methodologies (art-based research, grounded theory), and complex constructions of instruments for data collection, which are some of the recent research trends in education and publication in relevant international educational scientific journals.

Based on the analysis of these parameters, we predict that in the future, most research in the field of pedagogy will be done with the help of quantitative methodology and research techniques that require quantification of data and numerical indicators, and that those techniques will continue to be survey, evaluation and assessment as the most dominant ones. Regarding the thematic research trends, it is predicted that in the coming period, more and more papers will continue to be in the field of social sciences, if we are talking about the mentioned journals, because those are the journals that focus on publishing papers mostly from the area of education at all levels. Possible trends in pedagogical topics research are also predicted in the time to come. The best way for universities to remain relevant is innovation and the introduction of dynamic and new teaching methods; innovative pedagogy-defined as theories and pedagogy and practice of teaching, learning and assessment for the world of modern technology (Sharples et al., 2015) -is the future.

In addition to the implications made in the discussion of the results of this analysis, the general conclusion of this study is that the two analysed journals play an important part in the development of Croatian pedagogy and research of education. Results imply that it is desirable to intensify the publishing of theoretical-comparative studies, historical studies, and research papers with qualitative methodology. It is also important to point out the lack of papers that were from the field of methodology (1.9 %). Given the number of research tools used in the empirical part of the research, and in relation to the preference of the positivist paradigm and the overcoming of the quantitative methodology, there is a more than obvious need for the popularization of research tools and methodological approaches that can be applied in pedagogical research, but also in general research of education.

It is important to mention that researching the journals in Croatian and world contexts can significantly contribute to the monitoring of external and internal changes that took place in Croatian (and world) education and pedagogy. Such indicators can represent a kind of a "hidden" curriculum of pedagogy and methodology of papers from the educational corpus, which can explain the origins, disappearances and solutions of certain pedagogic problems.

Further research should focus on monitoring the published papers in these two journals, as well as their comparison with journals of similar nature outside the Republic of Croatia. It would be important to explore the kind of methodology and the kind of research techniques prevailing in pedagogy in journals that are referred to in bases such as *Scopus*, the *Web of Science Core Collection* (*WoSCC*) or *Current Contents* (*CC*). Finally, one should point to one possible prediction, which is that in the coming period, the journals *Napredak* and *Život i škola* are faced with a significant publishing challenge since, at the moment, neither of these two journals are referred to in the mentioned bases. This is possible to achieve through the use of various research tools that contribute to a thorough research of a problem, different methodological approaches and their combinations, and even representation of the papers of all categorizations and of all scientific paradigms (positivist, post-positivist, critical theory, constructivism and participatory paradigm).

References

American Educational Research Association. (n.d.) *AERA Journals Online.* Retrieved June 10, 2019 from https://www.aera.net/Publications/Journals

Bamattre, R., Schowengerdt, B., Nikoi, A., & DeJaeghere, J. (2019). Time matters: the potential and pitfalls of using mixed methods approaches in longitudinal program evaluation. *International Journal of Social Research Methodology*, *22*(4), 335–349.

Bekhet, A. K., & Zauszniewski, J. A. (2012). Methodological triangulation: An approach to understanding data. *Nurse Researcher*, *20*(2), 40–43. https://doi.org/10.7748/nr2012.11.20.2.40.c9442

Bouillet, D., & Jokić, M. (2019). Characteristics of educational sciences research activity in European post-socialist countries in the period 1996 to 2013: Content analysis approach. *European Educational Research Journal*, *18*(5), 407–425. https://doi.org/10.1177/1474904119827462

Chang, C. (2017). Methodological issues in advertising research: Current status, shifts, and trends. *Journal of Advertising*, *46*(1), 2–20.

Drysdale, J. S., Graham, C. R., Spring, K. J., & Halverson, L. R. (2013). An analysis of research trends in dissertations and theses studying blended learning. *The Internet and Higher Education*, *17*, 90–100. https://doi.org/10.1016/j.iheduc.2012.11.003

Dubovicki, S. (2017). Futurološke metode istraživanja [Futuristic research methods]. In S. Opić, B. Bognar, & S. Ratković (Eds.), *Novi pristupi metodologiji istraživanja odgoja* (pp. 203-221). Učiteljski fakultet Sveučilišta u Zagrebu.

Dubovicki, S., Mlinarević, V., & Velki, T. (2018). Istraživački pristupi i metodološki okviri u istraživanjima budućih učitelja [Research approaches and methodological framework in the research of future teachers]. *Nova prisutnost 16*(3), 595-611.

Dubovicki, S., & Munjiza, E. (2019). *Bibliografija "Života i škole" 1982. - 2017.* [*Bibliography of the journal "Život i škola" 1982. – 2017.*]. Fakultet za odgojne i obrazovne znanosti Sveučilišta Josipa Jurja Strossmayera u Osijeku.

Field, A. P., & Gillett, R. (2010). How to do a meta-analysis. *British Journal of Mathematical and Statistical Psychology*, *63*, 665-694.

Forum Qualitative Sozialforschung. (n.d.). Retrieved June 10, 2019, from http://www.qualitative-research.net/index.php/fqs/index

Gal, I., Ginsburg, L., & Schau, C. (1997). Monitoring attitudes and beliefs in statistics education. In I. Gal & J. B. Garfield (Eds.), *The Assessment Challenge in Statistics Education* (pp. 37–51). IOS Press.

Haslam, S. A., & McGarty, C. (2014). *Research methods and statistics in psychology*. London: Sage.

Honorene, J. (2017, April 5). *Understanding the role of triangulation in research*. Scholarly Research Journals. http://www.srjis.com/pages/pdfFiles/149544238718. %20HONORENO %20JOHNSON.pdf

Ivankova, N. V., & Plano Clark, V. L. (2018). Teaching mixed methods research: Using a socio-ecological framework as a pedagogical approach for addressing the complexity of the field. *International Journal of Social Research Methodology*, *21*(4), 409–424.

Journal of Curriculum Studies. (n.d.). Taylor & Francis Online, Retrieved June 10, 2019, from https://www.tandfonline.com/loi/tcus20

Kazak, A. E. (2018). Editorial: Journal article reporting standards. *American Psychologist, 73*(1), 1–2. http://dx.doi.org/10.1037/amp0000263

Kronick, D. A. (1976). *History of scientific and technical periodicals*. Metuchen, NJ: Scarecrow.

Lavrnić, I., Petrović, Ž., & Ratkovčić, B. (1982). *Zbornik u povodu tridesete godišnjice izlaženja Života i škole, časopisa za pedagoška i kulturno prosvjetna pitanja 1952.–1982.* [Proceedings of the thirtieth anniversary of the publication of Život i škola, Journal of Educational and Cultural Educational Issues 1952–1982.]. Zavod za prosvjetno-pedagošku službu za područje zajednica općina Osijek.

Leech, N. L., & Onwuegbuzie, A. J. (2007). An array of qualitative data analysis tools: A call for data analysis triangulation. *School Psychology Quarterly, 22*(4), 557–584.

McChesney, K., & Aldridge, J. (2019). Weaving an interpretivist stance throughout mixed methods research. *International Journal of Research & Method in Education*, *42*(3), 225–238.

Munjiza, E., & Dubovicki, S. (2012). Šezdeset godina Života i škole 1952. – 2011. [Sixty years of Život i škola (1952 – 2011)]. *Život i škola*, *27*(1), 11–37.

Napredak [Progress] (published numbers of the journal: 2012. – 2017.). (n.d.). Portal of Croatian Scientific and Professional Journals, retrieved May 25, 2019, from https://hrcak.srce.hr/napredak

Oliver-Hoyo, M., & Allen, DD. (2006). The use of triangulation methods in qualitative educational research. *Journal of College Science Teaching*, *35*(4), 42–47.

Petrović, Ž. (1981.) *Bibliografija 30 godišta časopisa Života i škole 1952. - 1981.* [Bibliography of the 30th Anniversary of the journal Život i škola 1952-1981]. Zavod za prosvjetno-pedagošku službu za područje zajednica općina Osijek.

Poljak, V. (1991). *Didaktika* [*Didactic*]. Zagreb: Školska knjiga.

Psychological Bulletin. (n.d.) American Psychological Association, retrieved June 10, 2019, from https://www.apa.org/pubs/journals/bul/

Raman, S. (Ed.) (2016). *Emerging trends in higher education pedagogy*. WOU Press.

Rock A. J., Coventry, W. L, Morgan, M. I., & Loi, N. M. (2016). Teaching research methods and statistics in eLearning environments: Pedagogy, practical examples, and possible futures. *Frontiers in Psychology*, *7*, Article 339. https://doi.org/10.3389/fpsyg.2016.00339

Sharples, M., Adams, A., Alozie, N., Ferguson, R., FitzGerald, E., Gaved, M., McAndrew, P., Means, B., Remold, J., Rienties, B., Roschelle, J., Vogt, K., Whitelock, D., & Yarnall, L. (2015) *Innovating pedagogy 2015: Open University innovation report 4*. Institute of Educational Technology. https://iet.open.ac.uk/file/innovating_pedagogy_2015.pdf

Strugar, V. (2019). *Napredak 1910. – 1945. Bibliografija* [*Napredak 1910. – 1945. Bibliography*]. Zagreb: Hrvatski pedagoško-književni zbor.

Subotić, M. (1972). *20 godina uzlaženja časopisa Života i škole* [*20 years of the journal Život i škola*]. Osijek: Zavod za unapređivanje osnovnog obrazovanja.

Topolovčan, T. (2016). Art-based research of constructivist teaching. *Croatian Journal of Education*, *18*(4), 1141–1172.

Topolovčan, T. (2017). Utemeljena teorija u istraživanjima odgoja i obrazovanja [Grounded theory in educational research]. In S. Opić, B. Bognar, & S. Ratković (Eds.), *Novi pristupi metodologiji istraživanja odgoja* (pp. 129–149). Zagreb: Učiteljski fakultet Sveučilišta u Zagrebu.

Life and school: Journal for the theory and practice of education (published numbers of the journal: 2012. – 2017.). (n.d.). Portal of Croatian Scientific and Professional Journals, retrieved May 25, 2019, from https://hrcak.srce.hr/zivot-i-skola

Evaluation of the Practical Pedagogical Training of Students in the Department of Geography at the Faculty of Arts, University of Maribor

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Abstract The article discusses how students of the pedagogical study programme Geography at the Faculty of Arts Maribor are connecting theoretical academic knowledge with their pedagogical experience. The questionnaire is used to establish students' personal reflections of competences, set in the study programme and self-evaluation of their own achievements at the end of their pedagogical training. They identified the importance of three sets of subjects (a set of general subjects of pedagogical, psychological and didactic field, a geographical didactic set, and a set of elective subjects), as well as up to five different forms of pedagogical activities. Results show that he participating students are satisfied with the competencies and their achievement of them, and that they are aware of the need for further professional growth. The most important evaluated competences for the successful work of teachers are in the field of defining the learning objectives and adjusting the planning and carrying out of lessons to the needs and capabilities of students and in the field of using different methods, forms and techniques of teaching, assessing and grading knowledge. The respondents feel least competent in anticipating possible problems during pedagogical work in the classroom and when planning how to solve them.

Keywords: student, geography, teacher, training, competence.

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Introduction

The best teachers incorporate a wealth of "knowledge-in-action" into their activities, and it is therefore essential for students to gain as much practical experience as possible throughout the duration of their studies. In doing so, care must be taken to ensure that these experiences are diverse and appropriately intensified (Marentič Požarnik, 2000; Thiessen, 2002). It is stated in *Zelena knjiga o izobraževanju učiteljev* [Green Book on Teacher Education] that:

> … professionalized models of teacher education enable the development of a wide range of professional activities, which teachers adapt to individual participants, objectives, tasks, content and situations. The development of these activities requires a wide foundation of knowledge, as well as a coordinated and coherent practice, which enables (future) teachers to become familiar with learning situations in which they can connect theory and competent reflective activity. (2001, p. 62)

With the academic year 2010/2011 the Faculty of Arts Maribor started to implement the double-major pedagogical second-cycle study programme Geography at the Department of Geography, in which -taking the above-mentioned into consideration -it was stated that future geography teachers need extensive and research-reflective knowledge of geography and of teaching geography, as well as proven forms and methods of the practical application of knowledge. Essential professional qualities of geography teachers include professional autonomy, pedagogical competences and, of course, the capacity for critical intellectual activity. The curriculum of the pedagogical study programme Geography is based on the recommended study structure that was provided by the Senate of the Faculty of Arts of the University of Maribor. This study structure was developed on the basis of the results of the research project entitled "Pedagoški modul, podporne aktivnosti za implementacijo bolonjske prenove ESS VS 06-09" [Pedagogical Module, Support Activities for the Implementation of the Bologna Reform ESS VS 06-09]. The project was carried out in 2007 by the most prominent researchers in the field of teacher education in Slovenia from all its three universities, including researchers from the Faculty of Arts of the University of Maribor, in collaboration with the Ministry of Higher Education, Science and Technology. In accordance with the line ministry's working group's recommendation for the reform of the pedagogical programmes, the "professional part" of pedagogical programmes should encompass at least 60 credits, which is the equivalent of one year of study, whereby at least a quarter of it should be teaching practice (Dvopredmetni pedagoški študijski program druge stopnje Geografija, 2019).

The double-major second-cycle study programme Geography thus consists of courses from the field of geography with the objective of learning about different spatial units (from the local, regional and continental level to the global level, 30 ECTS), as well as courses from the fields of pedagogy, didactics and psychology (the so-called PDP module), in the framework of which students acquire theoretical and practical knowledge in the field of the education and profession of a geography teacher (60 ECTS). The courses in the second set are common to both fields of studies of the double-major study programme. The programme includes practical pedagogical training of students (pedagogical practicum), consisting of an observational practicum (2 ECTS) and a subject practicum; the latter is comprised of the pedagogical practicum Geography 1 (3 ECTS) and the pedagogical practicum Geography 2 (4 ECTS). The pedagogical practicum consists of in-class observation of teaching lessons independently, and of pedagogical practice. The pedagogical practice consists of one week in a primary school and one week in a secondary school; additionally, in the curriculum, there is one week of dispersed pedagogical practice, which is carried out at different times and is optionally thematic. The share of practical training in the field of the pedagogical study programme Geography is 13.3 % (Dvopredmetni pedagoški študijski program druge stopnje Geografija, 2019).

The fundamental objectives of the pedagogical study programme Geography are: (1) To educate future teachers who, by the time they complete the study programme, will have the knowledge, skills and competences which -by international standards - are considered to be fundamental in the field of educating geography teachers, and will qualify these teachers to teach geography at both the primary and the secondary school level; (2) to educate future teachers who will be qualified to identify and analyse current processes and conditions in the field of education and to transfer these findings into documents and actions that are important for the development of education in both a general sense and in the context of teaching geography; (3) to educate future teachers who will be able to critically evaluate the natural-geographical, social, economic and ecological conditions in the region/geographical area with the purpose of educating for sustainable development.

The programme also defines 15 subject-specific competences in teaching geography (Dvopredmetni pedagoški študijski program druge stopnje Geografija, 2019).

The purpose of the practical pedagogical training of students is to train them to systematically observe how teachers, experienced practitioners and fellow students teach, as well as to train them to plan, perform and evaluate lessons in accordance with modern pedagogical-psychological and didactic theoretical bases and good practice. Furthermore, the purpose is to develop students' awareness which they need to continuously reflect upon their own teaching practices, to adapt the planning and implementation of learning units to the needs of students, to collaborate with other teachers, as well as to continue their professional development and thus their professional growth. To facilitate this, a portfolio as supporting pedagogical documentation was introduced in the process of the pedagogical training of geography students, thus enabling students to self-reflect and have proof of their practical pedagogical achievements, as well as enabling their mentors (teachers-mentors and experts for didactics of the subject) to individually monitor and evaluate the students' progress and achievements (Kolnik et al., 2007). Learning in order to participate in a knowledge-based society has to be focused on forming skills of independent, critical thinking and deliberation, on the effective handling of sources and information, on team collaboration and lucid communication, as well as on presenting of ideas. The portfolio strives for the afore-mentioned and at the same time represents an opportunity to see the quality of a particular student's progress and the results of his or her work also in the field of the so-called tacit knowledge - skills, mental abilities, attitude to learning and the profession, and so forth (Klenowski, 2002; Sentočnik, 2004). By the end of the practical pedagogical training, students are expected to have developed competences related to work both in and outside of the classroom, competences related to school, as well as competences related to their own professionalism (Kolnik et al., 2007).

Study: Evaluating practical pedagogical training as part of the pedagogical competence of future geography teachers

The evaluation of practical pedagogical training as part of the pedagogical competence of future geography teachers, along with the portfolio (the map of achievements of students' practical pedagogical training), is part of a broader study entitled "Self-evaluation of the pedagogical competence of students -future geography teachers", which was carried out from the academic year 2016/17 to the end of the academic year 2018/19. It encompassed two generations of students of the second-cycle pedagogical study programme Geography at the Department of Geography at the Faculty of Arts of the University of Maribor. In this paper, the part related to students' self-evaluation of their competence in practical pedagogical work will be presented.

Definition of the content of the research

The basic research question for this part of the study was focused on evaluating the importance of the competences of students -future geography teachers -and their self-assessment of achieving these competences. They assessed competences that form part of both general and subject-specific competences but are mainly focused on the field of direct pedagogical training in the so-called practicums, and students are expected to attain them by the end of their studies. Furthermore, the students assessed to what extent they achieved these competences.
A more detailed objective of the study was to establish: (1) how much importance students ascribe to individual competences that they should attain/develop during their practical pedagogical training; (2) whether there are any differences in their evaluation of the importance of the three sets of subjects (the so-called PDP module, the geographical didactic module and the elective module); (3) how students evaluate the five organizational forms of practical pedagogical training to achieve their pedagogical competence; (4) whether students of the two observed generations assess individual research parameters differently.

The sample of participants

The basic surveyed population consisted of all the students that in the academic years 2017/18 (14 students) and 2018/19 (8 students) were enrolled in the second year of the double-major second-cycle study programme Geography at the Faculty of Arts of the University of Maribor. In total, 18 female students (81.8 %) and 4 male students (18.2 %) participated in the study.

Methodological definition of the research

The study was based on a descriptive and causal non-experimental method of empirical pedagogical research. As the research instrument a questionnaire was developed for students after they had completed two years of practical pedagogical education.

The anonymous questionnaire consisted of two sections and an introduction. In the introductory part, the purpose of the survey was explained, instructions for filling out the questionnaire were given, and respondents were asked to provide some general information about themselves. This was followed by two thematic sets, in which students were asked to evaluate their practical pedagogical training in terms of assessing their own activities and achievements. The first set of questions was related to the objectives of the practical pedagogical training and to the competences that the students achieved. The second set of questions was related to the students' assessment of three sets of subjects in the curriculum and to the students' assessment of the forms of practical pedagogical training, as well as to suggestions for the possibility of improving this training. In the first set, there were two five-point (descriptive) assessment scales, where the respondents were asked about the importance of students' individual competences. There were three questions in the second set. Two questions also included a five-point assessment scale (rank) to evaluate the relevance of both the previously set study areas and those they had added independently (their elective courses). The open-ended question regarding the extent of the practical training provided three options for a short answer. In the final part, students were asked to write down opinions, suggestions, reflections, praises, criticisms, weaknesses, strengths, which in their estimation could in the future help to further improve the activities of students, teachers and mentors in the framework of practical pedagogical training in the field of geography.

Data collection process

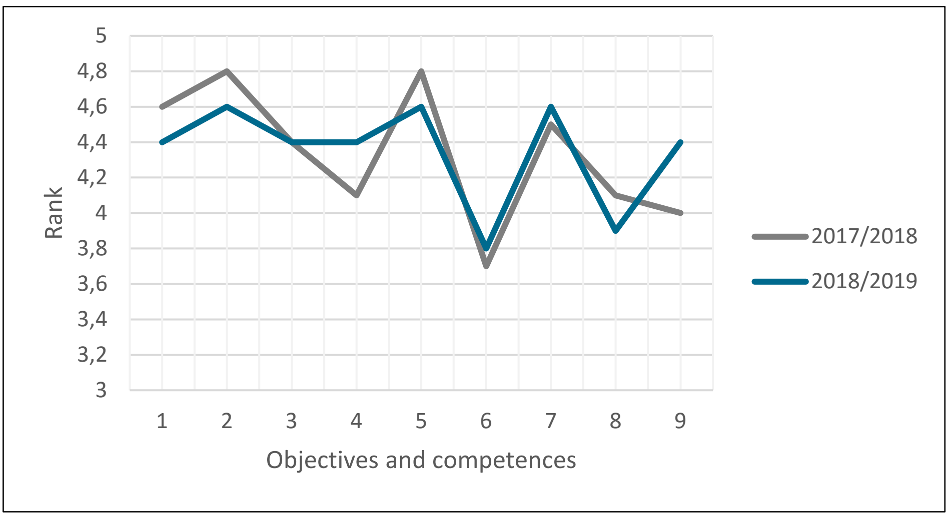
A broader survey encompassing two generations of students in their final year of studies was conducted between 2017 and 2019; in June 2018 (the 2017/18 generation) and July 2019 (the 2018/19 generation) students completed questionnaires. Ten students of the 2017/18 generation simultaneously completed an anonymous survey questionnaire at their final study meeting, while two, who had been absent at that time, did so afterwards. The 2018/19 generation of students simultaneously completed an anonymous survey questionnaire at their final study meeting at the faculty.

Processing the data

First, the data from the assessment scales were weighted: numerical values were assigned to the descriptively expressed levels, ranging from a score of 1, which signified the lowest importance, to a score of 5, which signified the highest importance. The questionnaires were statistically processed in accordance with the purposes and presumptions of the survey; due to the number of participants (14 students in the first group and 8 students in the second group), the research focused on the basic statistical parameters (mean rank and proportion of answers).

Results and discussion

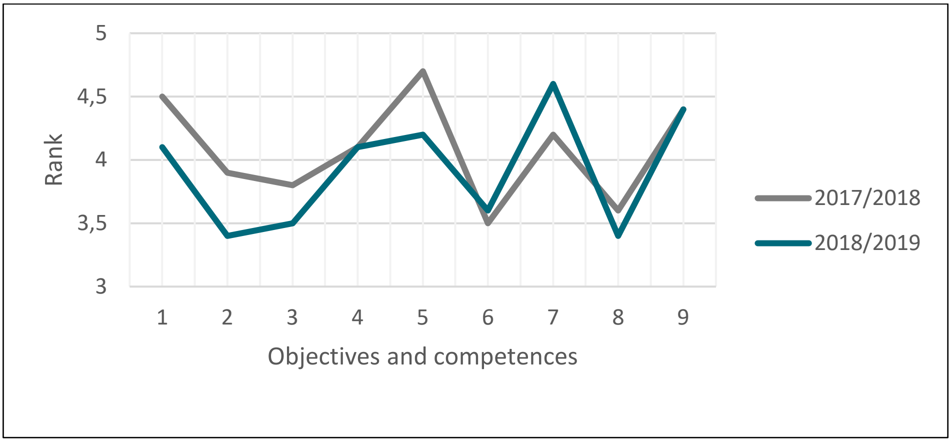
In the first set of questions, students assessed the part of their study programme that was related to the objectives of practical pedagogical training and evaluated the competences that they had achieved.



Graph 1: Evaluation of the competences of the practical pedagogical training of geography students

Legend of the objectives and competences: (1) Effectively observing and evaluating the pedagogical activities of experienced teachers and fellow students, and planning pedagogical activities based on this; (2) identifying/defining the learning objectives and adjusting the planning and carrying out of lessons to the needs and capabilities of students; (3) differentiating between students' level of cognitive, social and emotional development, learning style and strategies, and so forth; (4) applying the principles for a quality preparation, execution and evaluation of learning units; (5) using different methods, forms and techniques of teaching, assessing and grading knowledge; (6) anticipating possible problems during pedagogical work in the classroom and planning how to solve them; (7) critically evaluating one's own pedagogical performance; (8) applying a research approach to problem solving in teaching and pedagogical activities.

In accordance with the fundamental objective of pedagogical studies at the Faculty of Arts of the University of Maribor, upon successfully completing the practical part of their studies, that is graduating, students of double-major second-cycle pedagogical study programmes should possess nine sets of competences. The surveyed students evaluated these competences on a five-point scale based on their personal assessment of how important a certain competence is for the successful work of teachers. Both surveyed generations of geography students evaluated the importance of the competences with scores ranging from 3.7 to 4.8 (the 2017/18 generation) and from 3.8 to 4.6 (the 2018/19 generation). The competences "identifying/defining the learning objectives and adjusting the planning and carrying out of lessons to the needs and capabilities of students" and "using different methods, forms and techniques of teaching, assessing and grading knowledge" were given the highest score of 4.8 by the first surveyed generation. The second surveyed generation, however, rated three sets of competences as the most important (with a score of 4.6): the same two that the first group also rated the highest and "critically evaluating one's own pedagogical performance". The two surveyed groups rated the competence "anticipating possible problems during pedagogical work in the classroom and planning how to solve them" with the lowest score.



Note: Objectives and competences as stated in the Legend of Graph 1.

Graph 2: Evaluating self-competence at the end of the practical pedagogical training of geography students

In the self-evaluation of the attained competences upon completion of the practical pedagogical training, the surveyed students of the 2017/18 generation assessed their success in the range between the lowest evaluated achievement (with a score of 3.5) for their competence in the field of "anticipating possible problems during pedagogical work in the classroom and planning how to solve them", and highest self-assessment (with a score of 4.7) for their competence "using different methods, forms and techniques of teaching, assessing and grading knowledge". The second group of surveyed students evaluated two sets of competences as their lowest self-achievement (with a score 3.6): "applying a research approach to problem solving in teaching and pedagogical activities" and "identifying/defining the learning objectives and adjusting the planning and carrying out of lessons to the needs and capabilities of students". In the self-assessment, the highest score of 4.6 was given to the competence "critically evaluating one's own pedagogical performance".

A comparison of the questions about the importance of particular competences for the successful work of teachers and about the self-assessment of the attained competences shows that in both surveyed groups, the greatest differences in the assigned scores can be found in the set of competences from the field "identifying/defining the learning objectives and adjusting the planning and carrying out of lessons to the needs and capabilities of students". In the first surveyed group (the 2017/18 generation), the gap between the importance of the competence for successful work of teachers (4.8) and the achieved competence (3.9) is 0.9 points. In the second surveyed group (the 2018/19 generation), the gap is 1.2 (importance of the competence: 4.6; self-assessed achieved competence: 3.4). The 2017/18 generation of surveyed students evaluated the competence of "using different methods, forms and techniques of teaching, assessing and grading knowledge" with the highest score of 4.8, and also self-assessed its achievement of this competence with the highest score of 4.7. The difference between the two scores is minimal (0.1). The ability to "apply the principles for a quality preparation, execution and evaluation of learning units" was evaluated equally by both generations of respondents with a score of 4.1. The 2018/2019 generation of students surveyed assessed the competence of "critically evaluating one's own pedagogical performance" with 4.6 both in terms of its importance for successful work and self-assessment of its achievement.

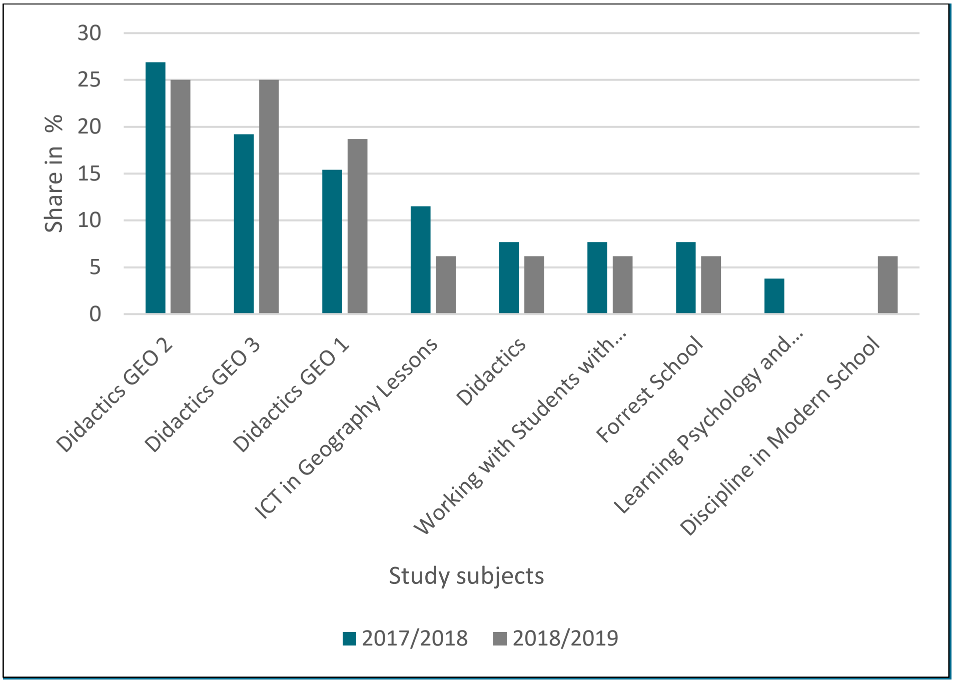
In the second part of the questionnaire three questions were posed. Two questions were based on a five-point assessment scale with which the surveyed students evaluated how important certain study fields are to them when it comes to achieving particular competences. The respondents had the possibility to add two individually selected subjects from the PDP modules to the list of compulsory study subjects and to evaluate them. The third question was related to the extent of practical pedagogical training; the respondents were able to choose one of three options for writing a short answer and justifying it.

Table 1: Evaluation of the importance of sets of study subjects (lectures, seminars and tutorials) for achieving the competence objectives of geography students

Sets of study subjects	**Rank** 2017/18	**Rank** 2018/19
PDP module: Pedagogy; Didactics; Learning Psychology and Adolescent Development; Working with Students with Disabilities	3.7	3.8
Didactics of geography set: Didactics of Geography 1, 2 and 3; ICT in Geography Lessons	4.7	4.7
PDP module electives and the number of students that selected them: *Lessons and Games 4* *Discipline and Managing the Class 4* *Forest School 3Multimedia 2* *Volleyball with Aerobic Exercises 1*	3.5	3.6

The geographical-didactic set of four compulsory study subjects received the highest score (4.7) in both surveyed groups assessing the importance for achieving competence. The two surveyed groups were also very much unified in evaluating the importance of compulsory study subjects of the so-called PDP module (with scores of 3.7 and 3.8) and of five elective study subjects (3.5 and 3.6) that they listed (a total of 14 entries). All 14 respondents (out of a total of 22) listed and evaluated the importance of one elective study subject that in their opinion had a significant impact on the competence of teachers. No one chose and evaluated two elective study subjects. The surveyed students had the opportunity to choose from 15 offered study subjects in the curriculum from a common list of the so-called PDP field.

Graph 3: Study subjects that provided the best insight into the future profession and work of a geography teacher



The respondents listed those two study subjects from the previously indicated fields of training for the profession that in their opinion gave them the best insight into their future profession and the work of a geography teacher. Respondents from the 2017/18 generation made a total of 26 responses, attributing the largest share of influence to the geographical-didactic set (Didactics of Geography 1, 2 and 3; ICT in Geography Lessons) with 67.7 %. With 19.2 % of all responses, the respondents attributed the second highest importance to three study subjects (out of four in total) from the so-called PDP module. Also on the list of the study subjects which the surveyed students of geography considered to have offered the most insight into their future profession was the elective study subject Forest School, which was listed twice (7.7 %). The second group of respondents also ranked the geographical-didactic subjects the highest with 74.9 % of all answers. Of the four compulsory subjects of the so-called PDP module, only two were selected (Didactics and Working with Students with Disabilities); combined they were attributed 12.4 % of influence on the respondents' insight into the future work of geography teachers. Two elective study subjects were included in the list, i.e. Discipline and Managing the Class and Forest School, with each of them being listed once. None of the respondents included the compulsory study subject Pedagogy in the list of study subjects, and two of the 15 pedagogical elective study subjects were included.

Table 2: Evaluation of the organizational forms of practical pedagogical training and the extent of their realization by geography students

Organisational form	Rank of importance		Preserve %		Increase %		Decrease %	
	2017/18	2018/19	2017/18	2018/19	2017/18	2018/19	2017/18	2018/19
Supervised in-class observation	4.5	4.7	54.5 %	50 %	45.5 %	50 %	0 %	0 %
Observational pedagogical practice	4.4	3.9	81.8 %	87.5 %	18.1 %	12.5 %	0 %	0 %
Continuous pedagogical practice	4.0	4.9	0 %	12.5 %	100 %	87.5 %	0 %	0 %
Dispersed pedagogical practice	4.5	4.8	45.5 %	37.5 %	45.5 %	62.5 %	9 %	0 %
Teaching lessons independently	4.5	4.5	54.5 %	100 %	36.5 %	0 %	9 %	0 %
Number of students	14	5						0 %

In accordance with the curriculum, the practical pedagogical training of the surveyed students was carried out in five organizational forms. The respondents indicated on a five-point scale how important each organizational form is for them in achieving pedagogical competence. They also indicated whether the extent of a certain organizational form should be expanded, reduced or preserved to the present extent. The students of the 2017/18 generation rated the continuous pedagogical practice with the highest score of 5; the respondents of the other group also rated it the highest with a score of 4.9. Both surveyed groups gave the lowest score to observational practice (4.4 and 3.9, respectively), although their assessment differed more, by 0.5.

Respondents in both groups stated in the highest proportion of affirmative answers that they would like to expand the extent of continuous pedagogical practice, whereby respondents of the 2017/18 generation choose this option in 100 % and the other group of respondents in 87.5 %. They also showed a high degree of agreement as far as preserving the present extent of observational practice is concerned (81.8 % and 87.5 %). There are differences between the groups with regard to the proportion of those who would like to increase the extent of dispersed pedagogical practice; a substantially a higher proportion (62.5 %) of respondents from the 2018/19 generation than from the 2017/18 generation (45.5 %) was in favour of this. 9 % of respondents from the latter group also expressed the opinion that the extent of dispersed pedagogical practice should be reduced. Opinions regarding the reduction of the number of teaching lessons independently were also in the same proportion.

Furthermore, this study wanted to establish how the respondents substantiated their opinions regarding preserving, expanding or reducing certain organizational forms of practical pedagogical training. In total, 16 respondents answered this question, with two respondents substantiating three organizational forms, two substantiating two organizational forms, and the other twelve substantiating one organizational form. Seventeen substantiations referred to increasing the extent of a certain organizational form, no one justified preserving the extent, and one respondent wrote a substantiation for reducing an organizational form. Their replies are listed in Table 3 in a somewhat abbreviated format, which, however, does not change their informational value.

Table 3: Substantiations for expanding/reducing the extent of the forms of practical pedagogical training for geography students

Organizational Forms	Substantiation: Increase
Supervised in-class observation	- more opportunities to learn about different types of schools as well as different types of teachers - each teacher has his or her own way of working and managing the class -it would be good to have more insight - with in-class observation one can get different ideas on how to teach, which is very important, especially in the beginning - each class is 'a world of its own'; the more of them one sees, the better one can prepare for diversity
Observational pedagogical practice	- first contact with practical work - as a student one has rarely had/has had little insight into how the school as a whole works - providing more insight into how one interacts with parents, co-workers, etc.
Continuous pedagogical practice	- currently there are many activities and a high workload over a short period of time -for both students and mentors - the most direct contact with the future profession - merely after one week one gets used to the rhythm and the students - not enough time to get to know students of different ages - the opportunity to learn about different good practices - in a week one cannot try out some of the more extensive teaching methods, e. g. project work
Dispersed pedagogical practice	- at least once more for a longer period, since the diversity of the teacher's work also changes throughout the school year - to gain experience in teamwork - opportunities for participating in school projects - one can widen the circle of pedagogical acquaintances, which may prove useful later, when searching for a job
Teaching lessons independently	- because one has both a teacher at school and an expert at the didactics of the subject at one's disposal and one can get good feedback
	Substantiation: reduce
Teaching lessons independently	- it is very stressful because one is being evaluated

In the concluding part, students were asked to freely write down messages, opinions, suggestions, reflections, praises, criticisms, weaknesses and strengths that they thought could help improve the work of students, teachers and mentors in practical pedagogical training in the field of geography. All of the students responded, but their messages differed both in scope (from a few sentences to a full A4 page) and in content. The following are four examples of messages.

Example of message 1: *"Especially during the pedagogical practice in the last semester, I devoted a lot of time to self-reflection and to the planning of my professional development. Although the work is inspiring, I had to weigh my options as far as my competences and employability are concerned. Sometimes planning one's professional development requires giving up (at least temporarily) one's personal ambitions or the desire to have a higher purpose. Such stories can have a very tragic ending. Therefore, one's career path should be formed slowly, carefully and honestly. I have learned that although fears lead to sleepless nights, they send us messages from our sub-consciousness that are worth paying attention to."* (male student, June 2018)

Example of message 2: *"In the course of all the lectures and seminars I would have liked to have had more guest lecturers/practitioners, as was for instance the case with the subject ICT in Geography Lessons, where in addition to lectures we had practical exercises in the classroom or in the form of fieldwork (GPS, mobile applications). I really like it if experts from different fields come and talk about their experiences."* (female student, June 2019)
Example of message 3: *"Teaching lessons independently could be assessed immediately after the pedagogical practice, when one still has a true sense of how it is to be in the classroom."* (female student, 2018).

Example of message 4: *"I am satisfied and everyone from the professors to the mentors deserves praise. If 5 years or 2 years ago someone had asked me whether I can imagine myself teaching a class, I would have said no, but now I hope to get a job as a geography teacher."* (male student, June 2018)

Conclusion

At the Department of Geography at the Faculty of Arts of the University of Maribor we encourage students to self-reflect by means of various forms of study, in individual and group dynamics, and especially with the method of putting together a portfolio. The most important part of the portfolio is the student's critical thinking and assessment of his or her own work and results. The results of the present study clearly show self-reflection to be an element of professional development that was firmly embedded in the personal and professional image of future geography teachers. We deem this to be a significant achievement.

The present study had four objectives. With regard to the first research objective, which was to determine how much importance geography students ascribe to developing particular competences during their practical pedagogical training, it can be concluded that both generations of surveyed students decidedly confirm the importance of all competences, since scores range from 3.7 to 4.8. Students ascribed the highest importance to the following competences: "identifying/defining the learning objectives and adjusting the planning and carrying out of lessons to the needs and capabilities of students", "using different methods, forms and techniques of teaching, assessing and grading knowledge" and "critically evaluating one's own pedagogical performance".

With regard to achieving particular competences, the surveyed students' self-assessment is that they achieved a high degree of all the competences, with scores ranging from 3.5 to 4.7. The competences in the following areas were ranked the lowest: "anticipating possible problems during pedagogical work in the classroom and planning how to solve them", "applying a research approach to problem solving in teaching and pedagogical activities", "identifying/defining the learning objectives and adjusting the planning and carrying out of lessons to the needs and capabilities of students". Students expressed the opinion that the competences they developed best were "using different methods, forms and techniques of teaching, assessing and grading knowledge" and "critically evaluating one's own pedagogical performance".

In educating future geography teachers at the Department of Geography at the Faculty of Arts of the University of Maribor the following are some of the key questions that we, as educators, ask ourselves: whether we successfully teach students how to think actively; whether we lay good foundations for their further professional development; whether we meet their individual needs. Based on how the students in the present survey assessed their own competences, it can be confirmed that the pedagogical study programme of Geography corresponds to the professional needs as perceived by students.

The self-assessments of competence attainment show that in the process of the second-cycle study, we sufficiently stimulate and direct professional development. Perhaps most important is the realization that students consider "critically evaluating one's own pedagogical performance" as one of the most important competences, as well as one of the competences they manage to achieve best.

This research has established that in the framework of the pedagogical study programme, some more attention could be devoted to working with students in order to develop a "research approach to problem solving in teaching and pedagogical activities" and to develop the ability to "anticipate possible problems during pedagogical work in the classroom and planning how to solve them." In the case of the latter competence, we, first and foremost, see opportunities in the framework of the so-called PDP module, while in the case of the former competence, opportunities exist in the framework of all study subjects. Grimmet (1994, as cited in Niemi & Kohonen, 1995, p. 73; see also Ivanuš Grmek et al., 2007) emphasizes the idea of progressive teachers who primarily see themselves as learners in the process of teaching and learning. The classroom is both a place where the teacher encourages students to learn and a place where they themselves learn a great deal about teaching. The teacher's most important characteristic is therefore the ability to constantly learn through their work -teaching, which he or she is constantly exploring. Eraut (1998, as cited in Day, 1999, p. 58) also points out that in addition to developing competences in the field of accomplishing various exercises, tasks and roles, teachers need to develop the need for continuous professional learning and development both on the individual level and in a social context.

The study also identified whether there are differences in assessing the importance of the three sets of study subjects (the so-called PDP module, the geographical didactic module and the module of electives) for attaining the target competences of geography students. The results affirm the concept of the pedagogical study programme at the Faculty of Arts of the University of Maribor, where the general contents of the so-called PDP module form the basis, while subject-specific didactic content is an upgrade of the pedagogical training. According to the surveyed students of geography, the latter is what comes closest to a real professional competence; therefore it is of exceptional and irreplaceable importance for the quality training of students of specific subject areas.

With regard to the research objective of wanting to find out how respondents assess the five organizational forms of practical pedagogical training in order to achieve their pedagogical competence, it can be concluded that the surveyed students value all forms of practical pedagogical training very highly, with continuous practice being valued the highest. Although there are minor differences between the surveyed generations of geography students, our research also shows that students want to increase the extent of all practical forms of study, which they substantiated in diverse and meaningful ways.

The need for a greater share of practical pedagogical training is not new; on the contrary, it has regularly been expressed by many generations of students in various forms of self-reflection. With the recent introduction of the Bologna study programmes at the Faculty of Arts of the University of Maribor, there have been positive developments, such as the introduction of dispersed and observational practice (Dvopredmetni pedagoški študijski program druge stopnje Geografija, 2019), however, this trend needs to be developed further in the future -the extent of all forms of practical training needs to be increased. Unfortunately, in the structure of pedagogical study programmes the focus is still on teachers having a good command of their field of expertise, that is the content that they will teach. However, *how* they will teach they are, to a large extent, expected to learn while already teaching. Thus, a limited number of hours are devoted to general pedagogical–psychological and special-didactic subjects and to pedagogical practice (see, e.g. Ivanuš Grmek et al. 2007; Marentič Požarnik, 2000).

As a basis for increasing the extent of practical pedagogical training there is a need to implement systemic changes that would more satisfactorily regulate the cooperation of faculties and schools.

References

Day, C. (1999). *Developing teachers. The challenges of lifelong learning*. London: Falmer Press.

Dvopredmetni pedagoški študijski program druge stopnje Geografija [Second cycle double major study program Geography]. (2019, September 16). http://www.ff.um.si/dotAsset/76011.pdf

Ivanuš Grmek, M., Javornik Krečič, M., Kolnik, K., & Konečnik Kotnik, E. (2007). Učitelji mentorji in visokošolski učitelji o kompetencah študentov -bodočih učiteljev [Teacher mentors and higher education on competeny of students -future teachers]. *Pedagoška obzorja: časopis za didaktiko in metodiko*, *22*(1/2), 28–42.

Klenowski, V. (2002). *Developing portfolios for learning and assessment: Processes and principles*. Routledge Falmer.

Kolnik, K., Konečnik Kotnik, E., Ivanuš Grmek, M., & Javornik Krečič, M. (2007). Mapa dosežkov praktičnega pedagoškega usposabljanja študenta: nova oblika študijske dokumentacije. In A. Vovk Korže, N. Vihar & A. Nekrep (Eds.), *Partnerstvo fakultet in šol kot spodbuda profesionalnemu razvoju učiteljev* [Faculty and school partnership as encouragement for teachers' professional development] (pp. 15–22). Maribor: Pedagoška fakulteta.

Marentič Požarnik, B. (2000). Uveljavljanje kompetenčnega pristopa terja vizijo, pa tudi strokovno utemeljeno strategijo spreminjanja pouka [Incorporating competency approach requires vision and professionally-established strategy of changing the teaching]. *Vzgoja in izobraževanje*, *37*(1),27–32.

Niemi, H., & Kohonen, V. (1995). *Towards new professionalism and active learning in teacher development: Empirical findings on teacher education and induction*. Tampere University.

Sentočnik, S. (1999). Portfolio, instrument za procesno vrednotenje učenčevega in učiteljevega dela [Portfolio, the instrument for process evaluation of the student's and the teacher's work], *Vzgoja in izobraževanje*, *3*, Ljubljana, str. 15–20.

Thiessen, D. (2002). A skilful start to a teaching career: A matter of developing impactful behaviors, reflective practices, or professional knowledge. *International Journal of Educational Research*, *33*(5), 515–537.

Zelena knjiga o izobraževanju učiteljev. Kakovostno izobraževanje učiteljev za kakovost v vzgoji, izobraževanju in usposabljanju [Green book on teacher education. Quality teacher education for quality education and training] (2001). Ljubljana: Ministrstvo za šolstvo, znanost in šport.

THE USE OF TEXTBOOKS IN THE TEACHING-LEARNING PROCESS

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Abstract The following paper presents the results of The Quality of Slovenian Textbooks (KaUč) project, the main objective of which is to develop textbook quality indicators for practical use in the validation and evaluation processes. The first part of the paper focuses on the definition of a textbook and its role in the process of education, since textbooks still represent the essential didactic tool in teaching school subjects. The empirical part of the paper explores the textbook use at different stages of curriculum implementation in the Slovenian primary and secondary schools. The results indicate that the primary school educators use textbooks in the revision and reinforcement stage, while the secondary school educators mostly use them in the stage of teaching the educational content. Thus, it is concluded that teachers consider secondary school students more mature than the younger students and assign them more comprehensive tasks.

Keywords: lesson stages, textbook quality, lesson, textbook, textbook use.

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The textbook is the main carrier of the curriculum and represents the dominant role in school subject teaching and learning (Sherman et al., 2016; Hadar, 2017).

It is the key schoolbook, used by students on a daily basis (Ivanuš Grmek, 2003; Mullis et al., 2012). Consequently, it is assigned the key role in the system of educational tools (Skela, 2008a).

However, the textbook is just one of the tools that help teachers achieve their educational goals. Teachers use teaching aids autonomously and plan individually when and how they will use them. In addition, teachers no longer have to follow the guidelines of one textbook, as several different textbooks are available for individual subjects. Teachers can choose the one that best suits both their teaching style and the specific characteristics of their students (Justin et al., 2003). Since the textbook is an important element of the teaching-learning process, the textbook politics must become part of the educational politics and receive more professional attention as well as a greater deal of systematic discussion (Turk Škraba, 2006).

Learning-oriented curricula does not only bring a great deal of autonomy for teachers, but it also enables various content and pedagogical approaches for the authors and the publishers. In addition, it positively effects the pluralisation of textbook supply (Kovač et al., 2005). Greater autonomy can encourage greater professional commitment, or it can, on the other hand, make teachers focus solely on the education and content solutions found in selected textbooks and other tools, such as workbooks, teaching aids, didactic instructions, worksheets, samples of teachers' lesson plans, and others. Publishers have been publishing professional teaching materials that include reliable and effective solutions for nearly every dilemma and dimension of the education process (Justin et al., 2003).

What is a Textbook?

Article 2 of the *Pravilnik o potrjevanju učbenikov* (2015) defined the textbook as the "basic teaching material to achieve the educational objectives and standards of knowledge defined in the curriculum and the catalogue of knowledge." According to these rules, school reader books are also classified as textbooks, as they are a collection of texts selected in accordance with the curriculum goals. Textbooks can either be printed or electronic (*Pravilnik o potrjevanju učbenikov*, 2015, Article 2).

Poljak (1983) considered the textbook as the basic teaching and learning material which enables students to acquire the necessary knowledge, develop critical, creative and dialectical thinking, and develop their mental skills, while Gak (2011) defined the textbook as one of the numerous sources that enables teachers to provide quality teaching. Kovač et al. characterized the textbook as "a textual teaching medium and part of educational tools that aids both, the efficiency of teaching as well as individual learning" (2005, p. 20). Ivanuš Grmek (2003) defined the textbook as a significant teaching-learning book, in which science and/or a certain discipline is transformed in a way that is accessible to all students.

Since it is intended for mass use, the principles of the majority must be considered in the creation of textbooks. Furthermore, the language should be adapted to learners' developmental stage and the content, range of problems and the level of complexity should comply with the particular developmental stage of average learners (Ivanuš Grmek, 2003).

Undeniably, the textbook is an important educational tool that mediates knowledge to new generations (Palló, 2006), and can be, according to Marentič Požarnik (1988), classified as one of the external factors of successful learning. It represents a particular kind of professional literature "defined by the content and target audience. On a broader scale, it is defined by the school system, since its content is 'determined' by the national curricula and the content and operational objectives of the subject or subject area" (Turk Škraba, 2006).

Accordingly, it can be concluded that textbooks have a great influence on the achievement of the curriculum goals (Hadar, 2017). According to Ersoy & Şahin (2012), textbooks continue to remain the educational material that is matched with the mandatory curriculum.

The textbook should enhance the teaching-learning process with the use of the didactic-methodological organisation of the content and the adapted visual and graphic material. Both the textbook content as well as its structure are designed for independent learning and acquiring various levels and types of knowledge. Its contents and structure depend on the school subject and the educational level (*Pravilnik o potrjevanju učbenikov*, 2015, Article 2).

Scientific content in the textbook is structured, transformed and simplified appropriately, as students have little prior knowledge of the content provided. Additionally, textbooks follow specific rules of the cognitive process wherein the content is didactically processed and hence understandable to students (Kovač et al., 2005). For this reason, the scientific content, logic, and terminology should be transmitted into textbooks by means of the so-called didactic transformations, which simplify, shorten and select the presented content. The didactic transformation occurs on three levels: the level of goals, the level of the scientific system and the level of the teaching content (Strmčnik, 1997, 2001). The didactic transformation is an extremely challenging process, since it must produce a functional and coherent textbook for its users (Turk Škraba, 2005). The divergences in textbooks are subject to different understanding of curricula designed on the basis of both specific pedagogical purpose as well as cultural and educational tradition (van den Ham & Heinze, 2018).

"In practice, we occasionally (still) encounter erroneous definitions. Some teachers, as well as students and their parents believe the textbook has the role and definition of the curriculum and often mistake the textbook for the curriculum" (Turk Škraba, 2006, p. 31). Hence, the textbook contents in educational practice are often strictly followed (Hadar, 2017). However, despite all its advantages and quality, a textbook can only assist teachers in achieving a certain standard of knowledge determined by the curricula or catalogues of knowledge and should only be one of the sources of knowledge, but under no circumstances a collection of the entire content of the subject (Turk Škraba, 2005).

In addition to textbooks, teachers also use other educational tools in accordance with the aim to achieve educational goals determined by the curriculum. Štefanc (2005) defined these additional aids as the material that is either specifically designed for the use in the classroom or individually chosen by the teachers for the purpose of teaching.

Characteristics of a Quality Textbook

The guiding principles of each school are quality, teaching quality, and the quality of knowledge, which undoubtedly depends on the quality of educational resources that aid both, teachers in the teaching process as well as students in the learning process (Cigler, 1997); textbooks, as educational resources, represent part of the complex system of education processes (Turk Škraba, 2005). A good textbook is the students' most important source of knowledge, since it helps them acquire knowledge and contributes to their personal development (Cigler, 1997). One of the key roles of a good textbook is also to encourage students to acquire knowledge independently (Turk Škraba, 2005). Due to ongoing changes in the world, one of the problems of textbooks is that they quickly become outdated and should be written in a way that they can be used for several years (Šmit, 2011).

According to Cigler (1997), a textbook's appearance should be attractive, especially its cover design, and its language should be appealing to the students. The textbook must also include students' expressive abilities and characteristics, while enriching their vocabulary (Zupanič, 2014). In addition, it should contain clear messages that motivate students to learn with comprehension, as opposed to learning texts they do not understand by heart. This can be achieved by providing clarity of the content, which is enhanced by images and illustrations. The content should provide basic facts, definitions and concepts. All illustrations, images and graphs should provide captions that direct students to the essence of their content (Cigler, 1997).

Turk Škraba (2005) evaluated textbook quality according to the following three perspectives: (1) From the perspective of the country, which is the provider of the education system and which legally defines the goals to be achieved by the participants in the education process; (2) from the perspective of the mediators, that is the teachers, who transfer the determined educational content to their students; (3) from the perspective of the users, that is the students, for whom the textbook is intended.

The official standards for the quality of teaching materials in Slovenia are defined in Article 3 of *Pravilnik o potrjevanju učbenikov* (2015). In accordance with these rules, a textbook can be approved if the following standards are met: (1) The textbook is consistent with the statutory goals of the educational system in the Republic of Slovenia; (2) if the goals, knowledge standards, and contents are in line with the current curriculum and the catalogue of knowledge; (3) if it is in line with the contemporary findings of the subject; (4) if it is appropriate from a methodological-didactic point of view; (5) if it adheres to the norms and criteria for school bag weight reduction, adopted by the National Education Institute Slovenia; (6) if it is suitable for the developmental stage and age of participants in the educational process, (7) if it is linguistically correct and appropriate, designed aesthetically, and visually and technically appropriate.

Unless the above-mentioned criteria are met, the Expert Council of the Republic of Slovenia for General Education shall not approve the textbook. In addition, a quality textbook should also abide by didactic principles, as they represent the basic guidelines of teaching. According to Strmčnik (2001), didactic principles represent an important theoretical foundation for education. For this reason, they also play an important role in conveying the content of the textbook.

Kovač et al. (2005) claimed that the following factors and principles should be followed in the creation of a quality textbook: (1) When evaluating the textbook content quality, it is necessary to take into account the principle of clarity, real-life and logical correctness and the system and structure of teaching; (2) from the perspective of the attitude towards the student, it is crucial to consider the zone of proximal development, and the principles of individualization and education; (3) the principles of activity and difficulty should be followed in terms of student activity; (4) the principle of economics and rationality should be considered in terms of the teaching process organization.

Jurman (1999) agreed that the textbook should be designed as clearly as possible and that its author should use examples and illustrations from the real world, while Kramar (2009) pointed out that learning is more successful, if the teaching material is clearly structured and systematic. By all means, a good textbook should be adapted to the students' developmental stage, as their physical and mental abilities differ. It is also important that students learn gradually. The textbook's level of difficulty should be adapted to the average student intelligence. However, below- and above-average talented students should be given adapted additional assignments (Jurman, 1999).

In accordance with didactic principles, Kovač et al. (2005) are convinced that a quality textbook's content and design encompass all guiding principles for quality textbooks. A quality contemporary textbook cannot merely be a "mechanical" didactic transformation of scientific content. It should also encourage active learning, a thorough understanding of teaching material, the interconnection of multiple subjects (Turk Škraba, 2006), students' willingness to learn and be creative, and enable them the opportunity for individualisation. The textbook should encourage students to cooperate and contribute to the development of language and values, such as criticism, democracy, tolerance and gender equality (Cigler, 1997).

Skela (2008b) claimed that a good textbook awakens students' curiosity, interest and attention and should not make them feel uneasy. It should help them build self-confidence and motivate them to learn. Educational content in the textbook should be relevant and useful. Above all, the textbook should accommodate students' different learning styles.

The Role of the Textbook in the Teaching-Learning Process

The textbook is one of the essential educational tools in the teaching-learning process (Kovač et al., 2005) and is intended for the use of both the students and the teachers (Remillard, 2005). The research conducted by Herlinda (2014) showed that teachers consider textbook the basic tool in the teaching process. It functions as a teaching or learning tool, providing learning activities for students (Gak, 2011; Štefanc, 2005). Furthermore, it functions both as an informative as well as a formative tool, as it provides knowledge and simultaneously enables the development of competence, skills and values (Kukanja-Gabrijelčič, 2015). In the process of teaching, textbook functions on both, didactical as well as educational level (Jurman, 1999).

It is a crucial learning tool (Hung Lau et al., 2018) as it provides learning resources and contents that should motivate students to learn. Additionally, it is important as a tool for independent learning and reinforcing the learned content (Kovač et al., 2005).

The textbook is subject to social control mechanisms, since it represents a source of knowledge that is officially recognized as suitable and objective. The open market for textbooks and a wide range of textbook supply suggest the democratizing of the school space and underline the importance of developing professional criteria for determining the quality of textbooks (Kovač et al., 2005). A quality textbook often represents the basis for a quality lesson, as found by Hadar (2017) in her research analysis dealing with the interaction between textbooks and teachers. The author found that (mathematics) teachers frequently strictly follow textbooks when delivering educational content. It is also important to note that teachers using various textbooks implement different didactic strategies. Moreover, textbooks influence the selection of teaching material. Ham & Heinze (2018) found that topics not included in textbooks are rarely discussed in class, as teachers mostly use them as a guiding instructional tool (Hung Lau et al., 2018).

Learning from a textbook can only be efficient if it is adapted for students and vice versa, as this is the only way students are able to learn how to use effective learning strategies. Authors can adapt textbooks to match the students' needs if they consider both the students' developmental stage as well as the level of comprehension. Textbooks are written in short comprehensive sentences and in simple and plain language, devoid of unnecessary foreign words. They have a good topical structure, using titles and subtitles, which makes navigation through text simpler. Including various tasks, questions, summaries and glossaries of new concepts, the textbook improves students' reading comprehension and greater cognitive abilities (Marentič Požarnik, 2019). Hence, Cigler (1997) claimed that the choice of textbook does not only depend on its quality but also on several other factors, one of the most important being the teachers' willingness to adapt their style of work to the style of teaching offered or demanded by the textbook. Another important factor is the students' ability to recognize the quality of the textbook.

In order to design a quality didactic textbook, authors should be well acquainted with contemporary didactics. They should be familiarized with the teaching-learning process structure and its principles. They should follow the teaching-learning activity principle and equip the textbook with a variety of activities. This allows students to construct knowledge through their own activity and learn the methods of learning (Poljak, 1983). Additionally, authors should consider the textbook's cover design, language, writing style, and artistic and graphic design (Ivanuš Grmek, 2003). Textbooks should be written in a way that assists students to learn the educational content and simultaneously complement and expand other sources of education. Teachers will be able to use the textbook effectively at all stages of the learning process, if the textbook is based on a proper didactic design (Poljak, 1983).

The role of the teacher is crucial in the initial stage of the teaching-learning process. Nevertheless, the function of the textbook should not be disregarded, since it is supposed to include the tasks, which students need to complete prior to learning new educational content. Textbooks adhering to this didactic criterion thus represent a source of information during students' preparatory work, which they can either do at home, or it can be integrated in the lesson by the teacher. The text including such tasks should be concise, since the introduction to new educational content is rather brief (Poljak, 1983).

The importance of the textbook becomes even greater when new educational content is discussed in the classroom. The objective of learning educational contents is to acquire knowledge. Therefore, this stage must be carefully and didactically designed. The content should be designed in a way that encourages students to learn and to complement and broaden teachers' instructions. Textbook authors should therefore follow the framework of desired knowledge and design it logically. They should highlight key points and present them in a logical sequence in the form of subheadings so that students can understand the basic topical content structure at a glance (Poljak, 1983).

As a secondary source, the textbook cannot replace the objective reality, however, the latter can be presented in several ways (original text, sketches, diagrams, and so forth). Furthermore, it should be presented clearly and unambiguously. In addition to the inclusion of facts, generalizations are also important. Students can understand them only through verbal explanation and clarification, which the author should include in the textbook in order to allow students different ways of generalizing. Another important aspect, relevant to didactic adequacy of the textbook, is considering both students' developmental stage and the balance between facts and generalizations. Teachers play an important role in this aspect, as they should be well acquainted with the textbook content and match their teaching style with that content by not merely listing textbook facts and thus increasing students' awareness (Poljak, 1983).

Practice (exercises) and reviewing the educational content are additional components of the teaching-learning process. The textbook should include additional work and exercises, which helps students practice tasks they should master. In order to ensure the sustainability of knowledge, textbooks should be designed in a way that allows students to revise their knowledge. Authors can indicate the importance of certain parts of the text by using various types of font and print. Additionally, reviewing can be indicated by forming generalization, summaries, graphics, and so forth (Poljak, 1983).

Students should have the possibility to self-determine the level of acquired knowledge within each lesson. Textbook authors can enable student self-assessment by providing self-assessment exercises. Students can evaluate their knowledge by answering questions and doing exercises that indicate whether they have acquired the operational level of knowledge or whether they have learnt the content merely to reproduce knowledge (Poljak, 1983).

To sum up the theoretical part of the study, we defined the textbook as a teaching tool and highlighted the characteristics of a quality textbook and its role in the teaching-learning process.

In the following part of the study, we present the results of the empirical research of textbook use in the classroom, obtained by the Quality of Slovenian Textbooks project (KaUč).

Empirical Research

The Purpose of the Empirical Research

Results presented are part of an extensive research carried out by KaUč), the purpose of which is to develop textbook quality indicators for practical use in the validation and evaluation processes.

The research deals with textbook use in the teaching process in the Slovenian primary and secondary schools. Our study presents results related to textbook use in the classroom, the use of different types of textbooks, and the use of other teaching materials.

In order to clarify the terminology dealing with the Slovenian education system in the following study, we present a brief explanation of the Slovenian basic and secondary education system.

Slovenian basic education lasts nine years. Students enter primary school at the age of 6 and complete it at the age of 15. The primary school education is divided into three education periods, each covering three grades. First education period includes grades 1, 2, and 3. During this period, all subjects are taught by one teacher, hereafter referred to as the elementary teacher. The second education period of primary school includes grades 4, 5, and 6. Subjects are taught by one teacher in the fourth and fifth grades, but in the sixth grade, subjects are taught by individual teachers, hereafter referred to as subject teachers. The third education period includes grades 7, 8, and 9, and subjects are taught by subject teachers. After basic education, students can choose to enter secondary school, which lasts three to four years, depending on the type of school, but generally, children attend secondary school from the age of 15 to 18.

We were given textbook use data for individual subjects by the primary school elementary teachers of the first and partly the second education periods, namely from the first to fifth grade of primary school, primary school subject teachers of the third education period, and secondary school teachers. We selected the textbook use research for those subjects, for which we received the most feedback, including the number of participating teachers and their answers.

The textbook use research of first period primary school teachers includes subjects such as Slovenian language, mathematics, social studies, environmental studies and engineering. The second period primary school teacher textbook use research mostly analyses mathematical and science textbooks for subject such as mathematics, natural science, and biology, and lastly, the secondary school teacher research mostly includes language and mathematical textbooks.

The Research Sample

The Research Sample of the Primary School Elementary Teachers

The survey includes 44 elementary teachers in the first and partly second education periods, teaching students from the first to fifth grade. 95.5 % of them are female. On average, the surveyed teachers are 43.8 years of age, with a minimum of 26 and a maximum of 59 years of age. Their average years of service amount to 20.6 years, with a minimum of 1 year and a maximum of 38 years. In terms of work experience, this is quite a heterogeneous group of teachers.

61.4 % of the surveyed teachers completed the seventh level of education and 63.3 % of them teach in the first education period. 34.1 % come from the Gorizia region of Slovenia, 27.3 % from the Central Sava region, and 22.7 % from the Southeast Slovenia region.

The Research Sample of the Primary School Subject Teachers

The survey includes 41 primary school subject teachers. 90.2 % of them are female. On average, the surveyed teachers are 44.2 years of age, with a minimum of 27 and a maximum of 64 years of age. Their average years of service amount to 18.7 years, with a minimum of 3 years and a maximum of 38 years. In terms of work experience, this is quite a heterogeneous group of teachers as well.

56.1 % of the surveyed teachers completed the seventh level of education. 56.1 % of them teach both in the second and third education period, 39 % only in the third and 4.9 % only in the second period. 36.6 % come from the Gorizia region of Slovenia and 26.8 % from the Central Sava region.

The research sample of the secondary school teachers

The survey includes 66 secondary school teachers. 77.3 % of them are female. On average, the surveyed teachers are 45.3 years of age, with a minimum of 30 and a maximum of 65 years of age. Their average years of service amount to 18.9 years, with a minimum of 1 year and a maximum of 39 years. In terms of work experience, this group is quite heterogeneous as well.
72.7 % of the surveyed teachers completed the seventh level of education. 61.5 % of them teach in the secondary general education and 21.5 % teach in secondary technical and professional education. 60.6 % come from the Central Sava region of Slovenia and 39.4 % from the Gorizia region.

Data collecting and processing procedures

We collected the data with the help of an online questionnaire, consisting of sets of questions and sets of evaluating scales. The constructed questionnaire is validated by the up-to-date scientific knowledge and by the practitioner teacher review. The reliability of the questionnaire was ensured by precise, specific questions, clear instructions as well as with the use of probing questions. The objectivity of the questionnaire is based on the fact that the interviews were conducted via web (individually, without the presence of the researcher). Furthermore, it mostly includes closed ended questions which enables an objective answer processing. Considering the limited sample of respondents, we only used the methods of descriptive statistics (frequency distributions, basic descriptive statistics), since the conditions for generalization methods (inferential statistics) were not fulfilled.

Results and Discussion

The survey includes titles of all textbooks used by the surveyed teachers. Table 1 below lists textbooks that the surveyed elementary teachers use with their students for individual subjects in grades from 1 to 5.

Table 1: Textbooks used in subjects such as Slovenian, mathematics, social science, environmental science, natural science and technology in individual grades from 1 to 5.

SLOVENIAN LANGUAGE		
Grade		*f*
1.	*Ko pravljice oživijo* [When fairy-tales come to life], a textbook, published by Izolit	1
	Jaz pa berem 1 [I Can Read 1], a school reader, published by Rokus Klett	1
2.	*Na mavrico po pravljico* [Fairy-tale on a rainbow], a textbook for the 2nd grade, published by Izolit	1
	Na mavrico po pravljico [Fairy-tale on a rainbow], a school reader for the 2nd grade, published by Izolit	4
	Kdo bo z nami šel v gozdiček [Who wants to join us in the forest], a textbook for Slovenian literature in the 2nd grade, published by Mladinska knjiga	5
3.	*Moje branje -svet in sanje* [My reading -world and dreams], a school reader for the 3rd grade, published by Rokus Klett	1
	S slikanico se igram in učim [I play and learn with my picture book], a textbook for the 3rd grade, published by Mladinska knjiga	2

4.	*Berilo 4, Razširi roke* [School reader 4, open your arms], published by Mladinska knjiga	1
	Radovednih 5: Berilo 4 [The curious 5: School reader 5], a workbook, published by Rokus Klett	3
5.	*Radovednih 5* [The Curious 5], a school reader for the 5th grade, published by Rokus Klett	2
	Na krilih besed 5 [On the wings of words 5], a school reader for the 5th grade, published by Mladinska knjiga	1
	Znanka ali uganka 5 [Solution or a puzzle 5], a workbook, published by DZS	1
	Na krilih besed, Berilo 5 [On the wings of words 5], a school reader, published by Mladinska knjiga	2
MATHEMATICS		
Grade		*f*
1.	*Prva matematika* [First Mathematics], published by Mladinska knjiga	5
2	*Matematika 2* [Mathematics 2], published by Mladinska knjiga	2
3.	*Matematika 3* [Mathematics 3], published by Mladinska knjiga	2
4.	*Radovednih pet, matematika 4* [Curious Five, Mathematics 4], published by Rokus Klett	3
5.	*Radovednih pet: matematika 5* [Curious Five, Maths 5], published by Rokus Klett	1
	Svet matematičnih čudes 5 [The World of Mathematical Wonders], published by DZS	3
SOCIAL SCIENCE		
Grade		*f*
4.	*Družba in jaz 1,* učbenik za 4. razred [Society and I 1, 4th grade textbook], published by Modrijan	3
	Radovednih pet, družba 4, učbenik za 4. razred [Curious Five, Social Science 4, 4th grade textbook], published by Rokus Klett	4
5.	*Radovednih pet: Družba 5* [Curious Five: Social Science 5], published by Rokus Klett	3
	Družba in jaz 2, učbenik za družbo v 5. razredu [Society and I 2, 5th grade social science textbook], published by Modrijan	6
ENVIRONMENTAL SCIENCE		
Grade		*f*
1.	*Dotik okolja 1* [A Touch of the Environment 1], published by Mladinska knjiga	2
2.	*Okolje in jaz 2* [Environment and I 2], published by Modrijan	1
3.	*Spoznavanje okolja 3* [Discovering the Science of the Environment 3], published by Mladinska knjiga	1
NATURAL SCIENCE AND TECHNOLOGY		
Grade		*f*
4.	*Od mravlje do sonca 1*, učbenik za 4.razred [From an Ant to the Sun, 4th grade textbook], published by Modrijan	3
	Naravoslovje in tehnika 4 [Natural Sciences and Engineering 4], published by Mladinska knjiga	2

	Raziskujemo in gradimo 4 [We are Exploring and Building 4], published by Mladinska knjiga	1
5.	*Radovednih 5: naravoslovje in tehnika* 5 [The Curious 5: Natural Sciences and Engineering 5], published by Rokus Klett	4
	Raziskujemo, gradimo 5 [We are Exploring and Building 5], published by Mladinska knjiga	2

Most textbooks within the same class are used by the Slovenian language teachers. Social science and natural science and technology teachers mostly use two or three different textbooks, and environmental science and mathematics teachers use one textbook within the same class.

Table 2 below lists textbooks for individual subjects used by primary school subject teachers.

Table 2: Textbooks used for mathematics, natural sciences, biology, chemistry, physics, geography, history, Slovenian, English, and German languages, art, music, engineering and technology, and home economics.

E-učbenik [E-textbook], Rokus Klett	1
BIOLOGY	
Dotik življenja [The touch of life], Rokus Klett	3
Spoznavam živi svet [Discovering the living world], DZS	2
Spoznavam svoje telo [Discovering my body], DZS	1
Interaktivni učbenik [Interactive textbook]	1
Pipinova knjiga [Pipin's book]	1
CHEMISTRY	
Od molekule do makromolekule [From the molecule to the macromolecule]	2
Od atoma do molekule [From the atom to the molecule]	2
Interaktivni učbenik [Interactive Textbook]	1
Kemija danes [Chemistry today], DZS	1
PHYSICS	
Moja prva fizika 1, 2 [My first physics 1, 2], Modrijan	2
E-učbenik [E-textbook], National Education Institute	1
GEOGRAPHY	
Raziskujem stari svet 7; *Raziskujem novi svet 8* [Exploring the old world 7; Exploring the new world 8], Rokus Klett	2
Spoznavam Evropo in Azijo; *Spoznavam Afriko in Novi svet* [Discovering Europe and Asia; Discovering Africa and the New World], Modrijan	2
Moja prva geografija [My first geography], Modrijan	1
Raziskujem Slovenijo [Exploring Slovenia], Rokus Klett	1
HISTORY	
Raziskujem preteklost 8, 9 [Exploring history 8, 9], Rokus Klett	2

Stari in srednji vek [Old and Middle Ages], Modrijan	1
SLOVENIAN	
Slovenščina za vsak dan 7, 8 [Everyday Slovenian 7, 8], Rokus Klett	2
Slovenščina 8, 9 [Slovenian Language 8, 9, E-textbook]	2
Od glasov do knjižnih svetov [From sounds to literary worlds], Rokus Klett	2
Gradimo slovenski jezik [Building the Slovenian language], Rokus Klett	2
Berilo 7 [School reader 7], Mladinska knjiga	1
ENGLISH	
Project 2, 3 4, Oxford	5
Touchstone 6, 9	2
Explorers 1	1
Happy Street, Oxford	1
GERMAN	
Ich und Deutsch 2, 3 [Me and German 2, 3]	2
Wegweiser 1 [Guidepost 1]	1
Nemški jezik za 7. razred [German for 7th grade], Založba Obzorja	1
MUSIC	
Glasba danes in nekoč [Music today and in the past], Rokus Klett	3
ART	
Likovno izobraževanje 6, 7, 8, 9 [Art education 6, 7, 8, 9]	1
Likovno izražanje 6, 7, 8 [Artistic expression 6, 7, 8], Debora	1
ENGINEERING AND TECHNOLOGY	
Tehnika in tehnologija [Engineering and technology]	1
Tehnika [Engineering], DZS	1
Tehnika [Engineering, Izotech]	1
HOME ECONOMICS	
Gospodinjstvo 6 [Home economics 6], Rokus Klett	3

The results indicate that teachers tend to use one textbook in the classroom for subjects such as mathematics, natural sciences, English, music and home economics, while teachers teaching other subjects tend to use various, mostly conventional textbooks.

Table 3 below lists textbooks for individual subjects which are used by secondary school teachers.

Table 3: Textbooks for subjects such as Slovenian, English, German, Italian, Spanish, mathematics, biology, chemistry, physics, information technology, history, psychology, sociology, and philosophy.3

SLOVENIAN	*f*
Na pragu besedila 1-4, ROKUS KLETT [At the Text's Threshold 1-4, Rokus Klett]	10
Barve jezika 1, 2, ROKUS KLETT [Language Colours 1, 2, Rokos Klett]	4
Mlada obzorja 1,2,3 [Horizons of the youth 1, 2, 3], DZS	4
Berilo 1-4, Umetnost besede [School reader 1-4, Art of the written word], Mladinska knjiga	3
Branja 1-4 [Readings 1-4], DZS	3
Z besedo do besede 4 [From word to word 4], Mladinska knjiga	1
ENGLISH	
On screen, Express Publishing	10
Headway pre-intermediate, Oxford	1
Success, Intermediate, Longman	1
Flash on English for tourism, Eli Publishing	1
Flash on English for cooking, catering & reception, Eli Publishing	1
GERMAN	
Themen aktuell 1, 2, Hueber Verlag	4
Optimal A1, A2, B1, Langenscheidt	3
Studio d, Cornelsen Verlag	2
ITALIAN, SPANISH	
Nuovo Espresso 1, Alma edizioni	1
Spazio Italia 1,2,3; Loescher	1
Nuevo Ven, Edelsa	1
Pasaporte, Edelsa	1
MATHEMATICS	
Planum, Spatium, Tempus, Modrijan	12
Matematika 1, 2, 3 [Mathematics 1, 2, 3], DZS	4
Linea nova, Modrijan	3
Matematika za triletne poklicne šole [Mathematics for three-year vocational schools], DZS	1
Matematika 1 [Mathematics 1], DZS	1
BIOLOGY	
Biologija celice in genetika [Cell biology and genetics], DZS	2
Biologija celce in ekologija z varstvom okolja [Cell biology and ecology and environmental protection], DZS	1
Zgradba in delovanje organizmov [Structure and function of organisms], DZS	1
Evolucija in ekologija [Evolution and ecology], DZS	1
Biologija 1, 2, 3, 4 [Biology 1, 2, 3, 4], Mohorjeva družba	1
Biologija -Ekologija [Biology -ecology], DZS	1
Od celice do organizma [From cell to organism], TZS	1

CHEMISTRY	
Kemija, snov in spremembe [Chemistry, Matter and Changes], Jutro založništvo	5
Verige in obroči [Chains and loops], Modrijan	3
Kemijo razumem, kemijo znam [I understand chemistry, I know chemistry], Jutro založništvo	1
PHYSICS	
Fizika 1, 2, 3 [Physics 1, 2, 3], Mladinska knjiga	4
INFORMATION TECHNOLOGY	
Osnove informatike: učbenik za pouk informatike v 1. letniku gimnazij in srednjih šol [Information technology basics: Information science textbook for the first year of secondary school], DZS	1
Računalništvo in informatika 1 [Computer science and information technology 1], E-textbook for information technology in grammar high schools, several publishers: UP, FRI, FERI	1
Informatika: učbenik za srednje izobraževanje [Information technology: Textbook for secondary education, SAJI	1
HISTORY	
Zgodovina 1, 2, 3, 4 [History 1, 2, 3, 4], DZS	2
GEOGRAPHY	
Obča geografija [General geography], Modrijan	1
PSYCHOLOGY	
Psihologija za srednje šole [Psychology for secondary schools], DZS	1
SOCIOLOGY	
Uvod v sociologijo [Introduction to sociology], DZS	1
PHILOSOPHY	
Filozofija za gimnazije [Philosophy for Grammar Schools]	1
ART	
Umetnostna zgodovina [Art History]	1

The tendency of using secondary school textbooks by the same publisher is most noticeable for subjects such as Slovenian language, English language, mathematics, chemistry, physics, and history.

As seen below, teachers evaluated the frequency of other materials they use in addition to textbooks with a 5-point rating scale, with 1 being *never* and 5 being *always*. Table 4 below shows the use of other teaching materials by the primary school elementary teachers.

Table 4: Structural percentages (f %) of elementary teachers according to the use of additional teaching materials.

Teaching material	Slovenian *f* %	Mathematics *f* %	Social science *f* %	Environmental science *f* %	Natural science and technolog	Rank
Workbook	80.0	93.1	69.2	60.0	55.6	1
Printable worksheets	31.6	30.3	14.3	50.0	16.7	5
Publisher's websites	54.1	46.9	66.7	64.0	83.3	2
E-textbook	44.4	43.8	40.0	58.8	41.7	3
Teaching materials available on the internet	43.2	36.4	40.0	61.1	41.7	4

The ranking of educational tools for different subjects in Table 4 above indicates that the workbook is used the most often, followed by publishers' websites, e-textbooks, teaching materials available on the internet, and lastly, printable worksheets.

The results indicate that in addition to the conventional, printed educational tools, elementary teachers increasingly use various electronic tools. The latter are more commonly used for subjects such as environmental science, natural science and technology and social sciences, such as Slovenian language and mathematics.

Subject teachers also listed a list of educational tools they use in addition to textbooks. The results are shown in the Table 5.

Table 5: Structural percentages (f %) of primary school subject teachers according to the use of other teaching materials for mathematics and natural science, biology, and biology and physics.

Education materials	Mathematics and natural science *f* %	Biology *f* %	Biology and physics *f* %	Rank
Workbook	42.5	44.4	50.0	2
Photocopiable worksheets	27.5	11.1	10.0	5
Publisher's website	25.6	22.2	25.0	4
E-textbook	55.3	53.8	55.0	1
Teaching materials available on the internet	47.5	40.7	40.0	3

The ranking of educational tools for different subjects in Table 5 above indicates that primary school subject teachers most commonly use the e-textbook, followed by the workbook in second place, teaching materials available on the internet in third place, publisher's website in fourth place, and photocopiable worksheets in fifth place. The subject teachers more commonly use electronic materials, the most common being the e-textbook.

Table 6 below illustrates the use of other teaching tools by secondary school teachers.

Table 6: Structural percentages (f %) of secondary school teachers according to the use of other teaching materials for foreign (mostly English) and Slovenian language, foreign language (mostly German), and mathematics.

Education materials	Foreign (mostly English) and Slovenian language f %	Foreign language textbooks (mostly German) f %	Mathematics f %	Rank
Workbook	56.6	75.0	69.2	1
Photocopiable worksheets	37.8	50.0	50.0	3
Publisher's website	14.8	5.0	0.0	5
E-textbook	22.2	15.0	15.4	4
Teaching materials available on the internet	51.9	45.0	50.0	2

The ranking of educational tools for different subjects in Table 6 above indicates that secondary school teachers most commonly use the workbook, followed by teaching materials available on the internet in second place, photocopiable worksheets in third place, e-textbooks in fourth place, and publisher's website in fifth place. The secondary school teachers more commonly use conventional additional materials, such as workbooks and photocopiable worksheets, than electronic materials.

Teachers evaluated the textbook use of individual subjects with five-point scale questionnaires (from 1 -*completely disagree* to 5 -*completely agree*) according to sets of "lesson stages".

Attention was given to textbooks of all subjects taught by elementary teachers. However, the analysis includes only the subjects that were evaluated by more than 20 % of teachers. These are Slovenian language, mathematics, social studies, environmental studies, and natural science and technology.

Table 7: Structural percentages (f %) of primary school elementary teachers according to the textbook use characteristic evaluation (agree, completely agree) for individual subjects.

Characteristic sets	LESSON STAGES
	I use the textbook for introductory motivation.
Slovenian *f* %	34.5
Mathematics *f* %	19.0
Social studies *f* %	33.3
Environmental studies*f* %	20.0
Natural sciences and technology *f* %	35.7
	I use the textbook to teach the educational content.
Slovenian *f* %	58.6
Mathematics *f* %	52.4
Social studies *f* %	60.0
Environmental studies*f* %	60.0
Natural sciences and technology *f* %	57.1
	I use the textbook to review and reinforce the lessons presented in the classroom.
Slovenian *f* %	75.9
Mathematics *f* %	81.0
Social studies *f* %	80.0
Environmental studies*f* %	73.3
Natural sciences and technology *f* %	85.7

Characteristic sets	LESSON STAGES
	I use the textbook as a guide for testing and evaluating students' knowledge.
Slovenian *f* %	55.2
Mathematics *f* %	61.9
Social studies *f* %	60.0
Environmental studies*f* %	66.7
Natural sciences and technology *f* %	57.1

The collected data indicate that elementary teachers most frequently use textbooks to review and reinforce the lessons (from 73.3 % to 85.7 %), however, they use textbooks less frequently for both testing and evaluating students' knowledge (from 55.2 % to 66.7 %), as well as for teaching the educational content (from 52.4 % to 60.0 %). Elementary teachers use textbooks in the stage of introductory motivation least frequently (from 19.0 % to 35.7 %).

Table 8: Structural percentages (f %) of primary school subject teachers according to the textbook use characteristic evaluation (agree, completely agree) for mathematics and natural science, biology, biology and physics.

Characteristic sets	Mathematics and natural science f %	Biology f %	Biology and physics f %
LESSON STAGES			
I use the textbook for an introductory motivation.	33.3	39.3	35.0
I use the textbook to teach the educational content.	59.0	60.7	55.0
I use the textbook to review and reinforce the lessons presented in the classroom.	79.5	71.4	75.0
I use the textbook as a guide for testing and evaluating students' knowledge.	64.1	64.3	65.0

In accordance with the articulation of the lesson, the primary school subject teachers most frequently use textbooks in the stage of reviewing and reinforcing the lessons presented in the classroom (from 71.4 % to 79.5 %), followed by textbook use as a guide for testing and evaluating students' knowledge (from 64.1 % to 65.0 %) and the textbook use for teaching the educational content (from 55.0 % to 60.7 %).

They use textbooks on rare occasions in the stage of introductory motivation stage (from 33.3 % to 39.3 %).

Table 9: Structural percentages (f %) of secondary school teachers according to the textbook use characteristic evaluation (agree, completely agree) for foreign (mostly English) and Slovenian language, foreign language (mostly German), and mathematics

Characteristic sets	**Foreign (mostly English) and Slovenian language *f* %**	**Foreign language (mostly German) *f* %**	**Mathematics *f* %**
LESSON STAGES			
I use the textbook for introductory motivation.	36.4	38.1	35.7
I use the textbook to teach the educational content.	70.9	81.0	71.4
I use the textbook to review and reinforce the lessons presented in the classroom.	61.8	57.1	50.0
Characteristic sets	Foreign (mostly English) and Slovenian language *f* %	Foreign language (mostly German) *f* %	Mathematics *f* %
LESSON STAGES			
I use the textbook as a guide for testing and evaluating students' knowledge.	65.5	66.7	50.0

The results in Table 9 show that secondary school teachers mostly use textbooks in the stage of teaching the educational content (from 70.9 % to 81.0 %), followed by the stage of evaluating students' knowledge (from 50.0 % to 66.7 %).

Less frequently, they use textbooks in the stage of reviewing and reinforcing the lessons presented in the classroom (from 50.0 % to 61.8 %), and least frequently in the stage of introductory motivation (from 35.7 % to 38.1 %).

Conclusion

The textbook is a teaching tool that facilitates both effective teaching as well as independent learning. The teacher can integrate the textbook into all stages of the teaching process. Simultaneously, the textbook also serves as a tool for students' independent learning (Kovač et al., 2005).

By interviewing teachers, we explored the textbook use for individual subjects in the teaching stages. However, it should be emphasized that the results gained refer only to certain groups of textbooks, since the selection was conditioned by a research sample of teachers and their professional autonomy while using textbooks in the educational process.

Several different textbooks are available for individual subjects, which enables teachers to select the one that is most suitable for their teaching style, as well as their students' needs and characteristics. The results of our study indicate that in addition to textbooks, primary school elementary teachers and secondary teachers most frequently use workbooks, while primary subject teachers most frequently use e-textbooks. With our analysis, we discovered that the primary school elementary, as well as primary school subject teachers mostly use textbooks in the stage of reviewing and reinforcing the lessons presented in the classroom. They rely on textbooks in the stage of introductory motivation least frequently.

The textbook use practice is somewhat different with secondary school teachers. Their textbook use is dominant in the stage of teaching the educational content. Similarly to primary school teachers, they use textbooks for introductory motivation least frequently.

We must be aware of the fact that the textbook no longer represents a book that should strictly be followed by teachers and students, since it merely represents one of the tools with which teachers can achieve educational goals (Justin et al., 2003).

Secondary-school teachers more frequently integrate textbooks in the stage of teaching the educational content, which is fundamental, as this is when students acquire new knowledge (Tomić, 2003). We believe this is due to the fact that older students have more experience identifying essential information in a text (Justin et al., 2003) and find it easier to follow teaching content explanations with the aid of the textbook. Secondary-school professors have confidence in their students and believe that by independent textbook use they will acquire the required knowledge and upgrade the teachers' teaching content. However, authors emphasize that the textbook should play a decisive role in the stage of teaching the educational content (Poljak, 1983) regardless of the level of schooling.

According to our observation, all teachers refer to textbooks in the stage of introductory motivation least frequently, which is understandable, considering the fact that in the initial lesson stage, the role of the teacher is essential (Poljak, 1983) and students must be motivated to learn from the teacher (Tomić, 2003). In order to promote textbook use in all lesson stages, proper textbook didactic design must be ensured (Poljak, 1983). The teachers should be professionally trained, as it is the professionally qualified teachers, mastering the content of their subjects, that can competently and sovereignly include the textbook in all lesson stages (Kovač et al., 2005 and Poljak, 1983).

References

Cigler, N. (1997). Kakšen je dober učbenik: kako napraviti, izbrati in uporabljati učbenike [What is a good textbook. How to write, choose and use textbooks]. *Vzgoja in izobraževanje, 28*(2), 34–36.

Ersoy, F., & Şahin, T. (2012). Examination of Social Studies textbooks in terms of approaches of values education. *Educational Sciences: Theory and Practice, 12*(2), 1547–1558. https://files.eric.ed.gov/fulltext/EJ987860.pdf

Gak, D. M. (2011). Textbook – an important Element in the Teaching Process. *Metodički vidici, 2*(2), 78–82. http://metodickividici.ff.uns.ac.rs/index.php/MV/article/download/771/781/

Hadar, L. L. (2017). Opportunities to learn: Mathematics textbooks and students' achievements. *Studies in Educational Evaluation, 55,* 153–166. https://doi.org/10.1016/j.stueduc.2017.10.002

Herlinda, R. (2014). The use of textbook in teaching and learning process: A case study of two EYL teachers. In *The 61st TEFLIN International Conference 2014: Proceedings. Book 1* (pp. 359–362). UNS Solo. https://pdfs.semanticscholar.org/bbb2/76b93aa1dcfe4b5648a90ddf098b32cdb0e2.pdf

Hung Lau, K., Lam, T., Hon Kam, B., Nkhoma, M., Richards, J., & Thomas, S. (2018). The role of textbook learning resources in e-learning: A taxonomic study. *Computers & Education, 118*. 10–24. https://doi.org/10.1016/j.compedu.2017.11.005

Ivanuš Grmek, M. (2003). Učbeniški kompleti v prvem triletju devetletne osnovne šole [Textbook sets for the first three years of primary school]. *Sodobna pedagogika*, *54*(5), 74–89.

Jurman, B. (1999). *Kako narediti dober učbenik: na podlagi antropološke vzgoje*. [How to design a good textbook: Based on educational anthropology]. Ljubljana: Jutro.

Justin, J., Zupančič, M., Schlamberger Brezar, M., Ivanuš Grmek, M., Vidmar, M., & Prevodnik, E. (2003). *Poročilo o rezultatih evalvacijske študije: Učbenik kot dejavnik uspešnosti kurikularne prenove*. [Evaluation study report: Textbook as the success factor in the implementation of curriculum renewal]. Ljubljana: Institutum Studiorum Humanitatis.

Kovač, M. K., Šebart, M., Krek, J., Štefanc, D., & Vidmar, T. (2005). *Učbeniki in družba znanja* [Textbooks and the society of knowledge]. Center za študij edukacijskih strategij, Pedagoška fakulteta, Univerza v Ljubljani.

Kramar, M. (2009). *Pouk* [Teaching]. Nova Gorica: Educa.

Kukanja-Gabrijelčič, M. (2015). Učbenik po meri učenca? Mednarodna primerjalna analiza vprašanj in nalog v učbenikih za zgodovino [Writing textbooks in accordance with student characteristics? International comparative analysis of history textbook questions and tasks]. *Annales: Series historia et sociologia, 25*(2), 385–398.

Marentič Požarnik, B. (1988). *Dejavniki in metode uspešnega učenja* [Factors and methods of successful teaching]. Ljubljana: Filozofska fakulteta.

Marentič Požarnik, B. (2019). *Psihologija učenja in pouka*: *Od poučevanja k učenju* [Psychology of learning and teaching: From teaching to learning]. Ljubljana: DZS.

Mullis, I. V. S., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics.* TIMMS & PIRLS International Study Center. https://files.eric.ed.gov/fulltext/ED544554.pdf

Palló, G. (2006). Encyclopedia as Textbook. *Science & Education, 15*(7–8), 779–799. https://doi.org/10.1007/s11191-004-1998-9

Poljak, V. (1983). *Didaktično oblikovanje učbenikov in priročnikov* [Didactic textbook and manual design]. Ljubljana: DZS.

Pravilnik o potrjevanju učbenikov [Rules on the approval of textbooks]. (2015). Uradni list RS, (34/2015, 27/2017).

Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research, 75*(2), 211–246. https://doi.org/10.3102 %2F00346543075002211

Skela, J. (2008a). Vrednotenje učbenikov v angleškem jeziku z vidika kognitivne teorije učenja [Evaluating English language textbooks from the perspective of cognitive theory of teaching]. In J. Skela (Ed.), *Učenje in poučevanje tujih jezikov na Slovenskem: pregled sodobne teorije in prakse* [Learning and teaching foreign languages in Slovenia: An overview of contemporary theory and practice] (pp. 154–178). Ljubljana: Tangram.

Skela, J. (2008b). *Smernice za avtorje učbenikov* [Guidelines for the authors of textbooks]. Ljubljana. http://www.izvirznanja.si/izvirznanja/izvirznanja/datoteke/5-002_SMERNICE %20ZA %20AVTORJE %20UCBENIKOV.pdf

Strmčnik, F. (1997). Znanstvenost učne vsebine v luči didaktične transformacije [The science of teaching content in light of didactic transformation]. *Sodobna pedagogika*, *48*(5–6), 231–245.

Strmčnik, F. (2001). *Didaktika: Osrednje teoretične teme* [Didactics: Central theoretical themes]. Ljubljana: Znanstveni inštitut Filozofske fakultete.

Šmit, N. (2011). *Nekateri vidiki vrednotenja učbenikov za pouk geografije v 7. razredu osnovne šole* [Some aspects of evaluation of textbooks for geography lessons in the 7th grade of primary school] (Publication No. 18723336) [Diploma thesis, Faculty of Arts, University of Maribor]. DKUM.

Štefanc, D. (2005). Učbenik z vidika didaktične teorije: značilnosti, funkcije, kakovost in problematika potrjevanja [Textbook from the perspective of didactic theory: Characteristics, functions, quality, and the validation problematics]. *Sodobna pedagogika*, *56*(4). 172–185.

Tomić, A. (2003). *Izbrana poglavja iz didaktike* [Selected didactic topics]. Ljubljana: Center za pedagoško izobraževanje Filozofske fakultete.

Turk Škraba, M. (2005). *Učbenik kot sredstvo za kakovostno učenje in poučevanje družboslovja: diplomsko delo* [Textbook as a tool for quality learning and teaching the social sciences: Diploma thesis] (Publication No. 24704349) [Diploma thesis, Faculty of Social Sciences, University of Ljubljana]. RUL.

Turk Škraba, M. (2006). Učbenik kot prvina učnega procesa [Textbook as the element of the teaching-learning process]. *Vzgoja & izobraževanje*, *37*(5), 31–34.

Van den Ham, A.-K., & Heinze, A. (2018). Does the textbook matter? Longitudinal effects of textbook choice on primary school students' achievement in mathematics. *Studies in Educational Evaluation, 59*, 133–140. https://doi.org/10.1016/j.stueduc.2018.07.005

Zupanič, K. (2014). *Pregled učbenikov za predmet spoznavanje okolja in mnenja učiteljev o njih* [Reviewing environmental science textbooks and teachers' opinions about them] (Publication No. 20681480) [Diploma thesis, Faculty of Education, University of Maribor]. DKUM.

Use of ICT in the Process of Cooperation with Parents Through Student Perspectives

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Abstract The use of ICT cannot improve cooperation itself, if it is not well thought-out, coordinated with the educational goals and focused towards increasing the quality of cooperation. General competences of educational workers also include the use of ICT, because they are expected to know how to make the best of the options of modern ICT with the purpose of improving cooperation. The process of developing digital competences in relation to a reasonable and focused use of ICT in education already begins during formal training of teachers. Using the qualitative SWOT analysis, we examined components and opportunities of cooperation with parents with the use of ICT, which were presented by students of the Faculty of Education of the University of Primorska (N = 40). The aim of the research was for students of the Faculty of Education to determine the understanding of cooperation with parents by means of ICT and search for new solutions.

Keywords: cooperation with parents, use of ICT, digital competences, cooperation components, partnership with parents.

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Partnership with parents is a relatively modern phenomenon, which defines the relationship between an educational institution and parents of an individual child. Cooperation with kindergartens or schools is of course as old as modern methods of organized schooling and education, and certainly each period in history, consistent with the values of the environment, technical knowledge and also unwritten rules, brought its own understanding of cooperation. Changes towards closer integration of family and educational institutions started in the second half of the 20th century, with the transformation of the understanding of family as the primary socialization factor. Parents slowly started entering the process of schooling and education, gradually strengthening their position within educational institutions (Lepičnik Vodopivec, 2012). Despite the theoretical definition of cooperation and partnership between an educational institution and parents, the implementation of ideal models always depends on numerous other factors. One of them is the use of ICT resources in the process of cooperation and partnership, so in addition to a historical overview, the paper will also focus on integration of technology in the process of cooperation and partnership between educational institutions and parents.

Importance of parental involvement

Parental involvement can be defined as "parental participation in the educational processes and experiences of their children" (Jeynes, 2005). Many studies suggest that there are strong links between academic achievements, social outcomes for children and parental involvement (Epstein, 2001; Jeynes, 2007; Hornby, 2011). Parental involvement is not only about parent-teacher meetings, but also about home-based parental involvement (listening to children while reading, homework supervision). In the last 40 years, this field has been recognized as important (Hornby, 2011), although as early as the first decade after Slovenia's independence, a linear diagram was in use, showing parents simply as those who drop their children off before and pick them up after the end of an organized educational process. This way children pass from one educational institution to another, until they ultimately find employment and become members of a community. The contemporary diagram suggests mutual integration of three parts, which constantly cooperate in ideal conditions: parents – kindergarten/school – environment/community (Epstein, 2001).

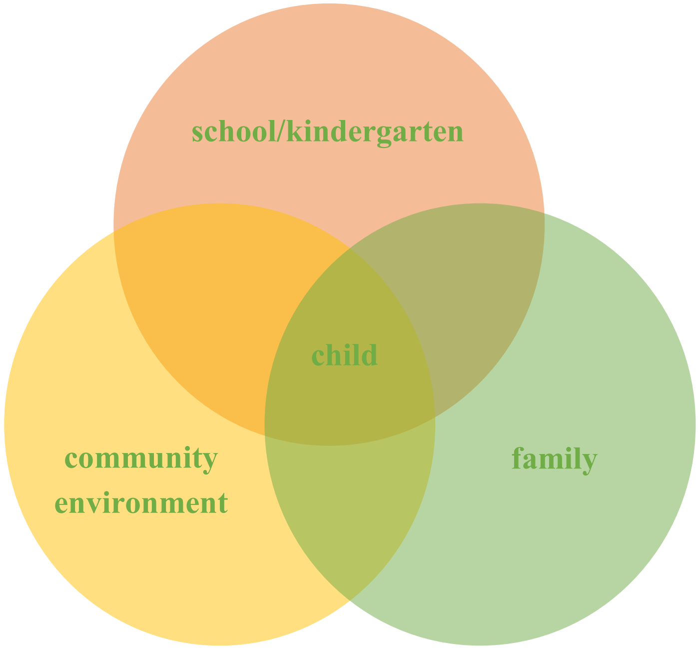

Figure 1: Integration of different contexts of a child's learning
(Epstein, 2001)

In accordance with the model, Epstein (2018) defined 6 different types of parent–school cooperation (also integration or involvement), in order to point out the diversity of involvement of parents in education of their children: communication, voluntary work, family learning (inclusion in a child's learning process; see also Passey, 2011), making decisions about relevant matters, cooperation with community. This model can also be connected to the ecological theory model, which was applied by Bronfenbrenner (1994) to explain various influences, which shape a child and impact growth, development and character building. When talking about cooperation and partnership with parents, we must bear in mind both Epstein's model and Bronfenbrenner's ecological systems theory, because we must always focus on the child, who is in the centre and is influenced by the integration of various factors.

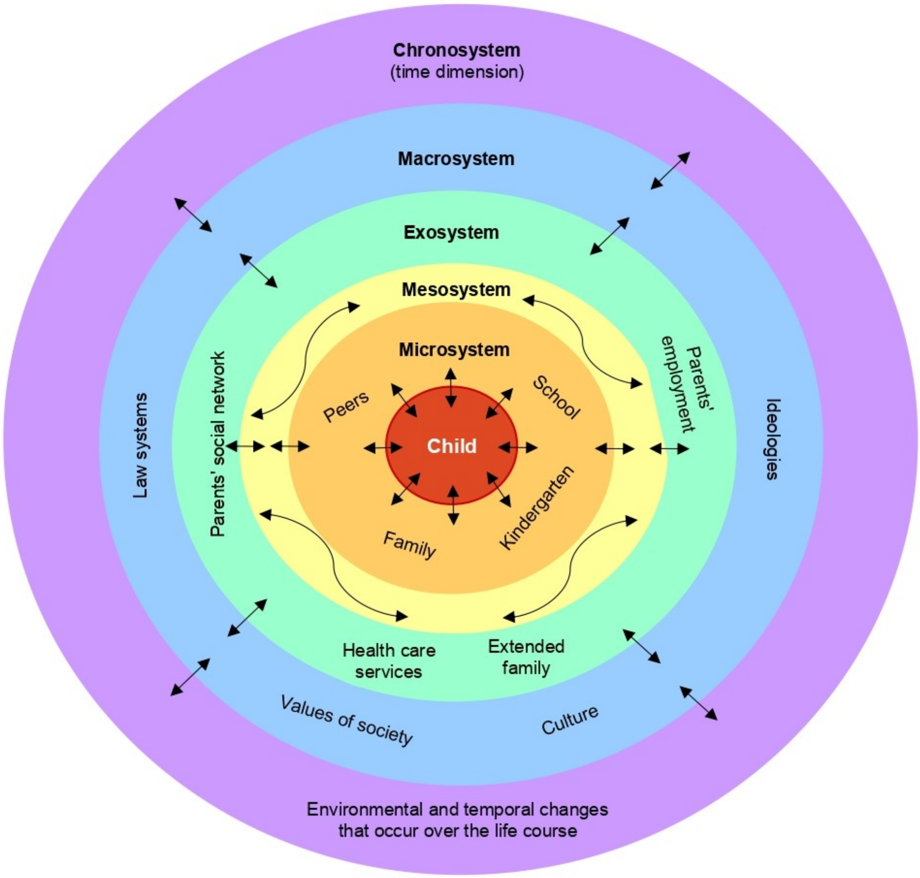

Figure 2: Bronfenbrenner's ecological systems theory
(Marjanovič Umek & Zupančič, 2009; Rhodes, 2013)

Epstein's model also coincides with the understanding of the process and development model, according to Kroflič (2001), which can also be transferred to the school as one of more fundamental guidelines of a contemporary kindergarten. This very connection of the model with the cultural and transmission model defines modern upbringing as "a relatively planned system of factors that support the development of children's personal traits and potentials" (Kroflič, 2001, p. 13). Therefore, at the turn of the century, we talk about changes at the level of understanding, criss-crossing and importance of mutual relations, and communication between educational workers, parents and children.

ICT and digital competences

In the 1990s, the changes in the society and industry were also followed by curricular changes, which suggested partnership as an equal relationship between the educational staff and parents towards the exchange of information, objectives, obligations and everything related to educational work. This further results in the strengthening of the active role and responsibilities of everyone included in the promotion of children's development. But even before educational workers faced up to the challenge and became qualified for development of partnerships between them and parents, or before this concept fully came alive within schooling and education throughout the vertical, information communication technologies stepped in – also with the purpose of improving communication and facilitating cooperation. Inclusion of technology in education started already in 1980s (Somekh, 2007), but this didn't have any relative impact on cooperation with parents. Within the last two decades, especially in recent years, technology -especially ICT -that can be used in schooling and education and that also enables the inclusion of parents in education of their children, started developing extremely fast. Learning, adaptation, changed practices and also inclusion of ICT in cooperation and partnership with parents is a long-term process, which requires flexibility of everyone included and possession of specific key competences (Anastasiades & Zaranis, 2017).

Educational workers need to have digital competence to use ICT in education (Brečko, 2016), which is also accurate in the process of cooperation with parents. Of course, we have to separate digital competences from digital literacy. Martin and Grudziecki (2006) emphasized that digital literacy consists of three levels: the first level contains digital competences (skills, concepts, approaches, etc.), the second level covers digital use (professional use) and the third level transformation (creativity and innovation).

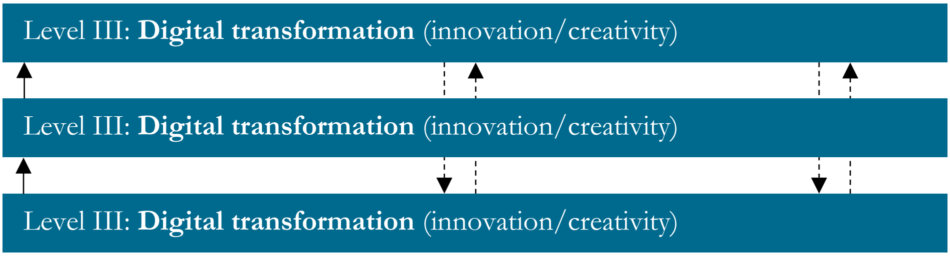

Figure 3: Levels of digital literacy
Source: Martin and Grudziecki (2006)

Digital competence is only a basic level, but it involves a wide range of skills - from the simplest to the most complex, containing critical, evaluative and conceptual approaches. As Martin and Grudziecki (2006) highlighted, professionals have to be careful when using one term or another. When we talk about digital literacy, we need to be aware of all three levels. Besides, digital literacy involves the successful use of digital competences in various life situations. According to this definition, educators, teachers, and other educators should have completed second and third levels in addition to the first level. In the following, we can not only talk about digital competences but, above all, about the digital literacy of all educators. On the other hand, for a successful two-way process, parents should have at least the first level (i.e. digital competences) developed.

Involving ICT in the process of parents' involvement

General competences of educational workers also include the use of ICT, but this does not mean only a technical application of an ICT resource, but also critical assessment at the level of content (Gavriloski et al., 2018), particularly the relevance of its use with regard to fundamental guidelines and achievement of goals in the process of cooperation and partnership with parents. The application thereof, of course, may also be influenced by attitude towards technology, which may significantly hinder the use of ICT resources in the educational process (Vitoulis, 2017), which can also be transferred to partnership with parents. The use of ICT resources certainly cannot improve cooperation, if it does not include a well thought-out and coordinated activity of all players with the purpose of increasing the quality of cooperation and partnership. The effect of greater inclusion, active cooperation and proactive and supportive approach of parents to the education of children can also reflect in the child's improved academic achievements and is related to their emotional stability, safety, acceptance and improved self-esteem (Passey, 2011). Greater inclusion in this context does not mean inclusion in schooling, but inclusion in the learning process towards ensuring support and activation of the proactive role of parents (Harris & Goodall, 2007).

The key component of partnership is gaining trust, which is the foundation of any form of cooperation (Lamovec, 1993; Lepičnik Vodopivec, 2012; Vec, 2002). Of course, inclusion of ICT in the process of cooperation and partnership with parents does not mean substituting personal contact, but should in this context suggest merely an upgrade, which becomes possible only after the establishment of partnership, and this is, of course, related to trust and requires time and motivational input of everyone included. In the period of quick flow of information and lack of time, it is crucial to understand and apply ICT as a resource that may facilitate some aspects of cooperation and partnership with parents. Dečman Dobrnjič and Černetič (2009) list the following as the reasons for the use of ICT in cooperation with parents: (1) being busy and not having enough time for parent-teacher conferences, so ICT reduces the time needed for communication; (2) speed, accessibility, reliability of information; (3) fast contact, timely action, assistance in decision-making and consultation with parents; (4) traceability of conversation; (5) lower costs for parents; (6) possibilities of greater integration; and (7) exchange of information among parents. Certainly, it is also required to list the reasons against the introduction of ICT, which mainly refer to the lack of personal contact, but also to the probability of misuse of information, insufficient qualification and lack of knowledge of those included, lack of equipment for ICT, and lack of non-verbal communication (Dobrnjič & Černetič, 2009).

The reasons for the introduction of ICT in the cooperation and partnership process with parents can be further complemented, considering that (1) ICT enables parents to be involved in their children's education faster, more reasonably and actively; (2) ICT supports more flexible working arrangements, which also impacts the process cooperation and partnership with parents; (3) ICT enables more flexible matching of information. In accordance with these findings, we propose the following diagram which suggests activation of the use of ICT in the process of cooperation and partnership with parents, if the following conditions are met: (1) trust, which is the fundamental building block of partnership, has been established between a school and parents; (2) a dialogue based on trust, respect and responsibility has been established between parents and the child; (3) school teaches the child in accordance with contemporary professional and scientific findings, thereby following modern educational principles, curricula and the White Paper on Education in the Republic of Slovenia. Use of ICT in cooperation and partnership will be reasonable, reliable, and manageable only upon mutual functioning and integration of all three parts and will quickly and timely match the challenges of cooperation between a school and parents. Of course, along with the inclusion of ICT in the cooperation and partnership process, educational workers and parents alike must possess digital competences and have positive attitude towards technology (Lepičnik Vodopivec & Gavriloski, 2002).

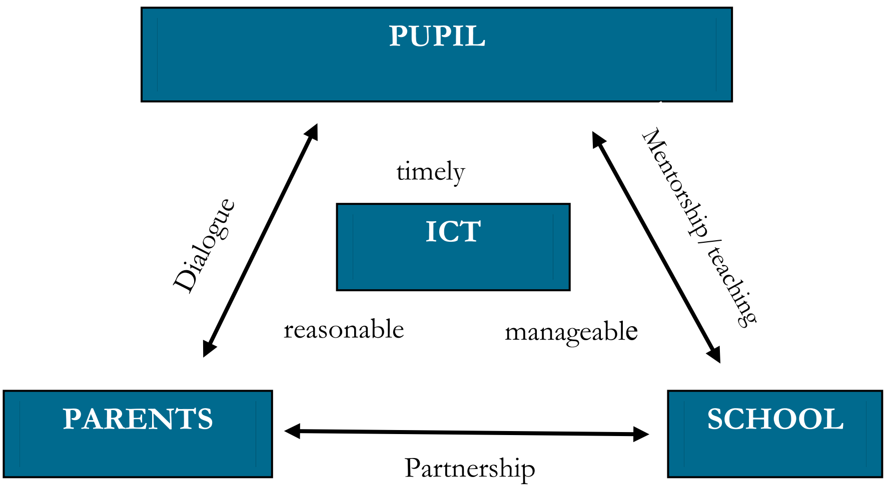

Figure 4: Diagram of cooperation between a school and parents
(Lepičnik Vodopivec & Gavriloski, 2002)

Definition of the research problem

Considering that digital competences and attitude of future educational workers towards ICT are also important in the use of ICT in the process of cooperation and partnership with parents, we wanted to know what possibilities of cooperation with parents with the use of ICT are proposed by students of the second year of the first-cycle university study programme Pedagogy.

Purpose of the research

The purpose of the research was to identify and evaluate students' suggestions about possibilities of cooperation with parents by means of ICT in order to gain a better understanding of their attitude towards the use of ICT in the process of cooperation with parents and gain a direct insight into research participants' knowledge of ICT resources.

Aims of the research

We wish to:

- Determine how students understand cooperation with parents;
- determine what possibilities of cooperation with parents by means of ICT are suggested by students;
- determine what attitude to the use of ICT in cooperation with parents is shown in the suggestions of students;
- determine which ICT resources (and applications) students know.

Methodology

The study used a qualitative approach and a descriptive method. We included 40 students from the second year of the university study program Pedagogy. In the first semester of the second year of the academic year 2018/2019, the research participants designed 11 posters within the subject Partnership with Parents and the Environment and presented the possibilities of cooperation with parents with the use of ICT. Students were familiar with the topic. The time frame for poster production was 1 month (December 2018). The instructions that guided the students were general and allowed them to choose the educational institution (kindergarten or elementary school) as well as content design. To gather as much information as possible in one place about the possibilities of engaging with parents with the use of ICT, the students were given simple instructions for creating posters. It was the free choice of content and educational institution that encouraged the students in finding options and solutions, as they did not simply follow closed instructions. Such an approach could, of course, remain solely on the strengths-weaknesses axis if the content had not been analysed with a SWOT analysis and the content had not been divided into internal (strengths, weaknesses) and external elements (opportunities, threats). The advantage of this kind of analysis is that it provides us with a deeper insight into the problem to make planning easier and better. In our case, it is a matter of planning to integrate ICT in the processes of cooperation with parents. The classic SWOT analysis used within the business sciences defines internal elements as those that are influenced by the individual (or business), while they do not influence external elements, although they may be influenced. The same is accurate in our case since educators influence the internal elements, and mostly respond to the external ones.

The posters mostly showed a tendency to understand the use of ICT in the process of cooperation with parents on the axis of strengths-weaknesses, so we placed the results under different components of strengths (information, time, spatial, relational) and weaknesses (information, technological, human, relational). However, such a division alone does not capture the complexity of ICT use and miss the opportunities we must seize and the dangers that need to be heeded. Therefore, the answers below were also analysed using a SWOT analysis. The individual components were content-specific and not predefined.

Results and discussion

The obtained content was initially divided between the arguments, which are inclined to the use of ICT in the process of cooperation and partnership with parents, and the arguments, which are not inclined to the use thereof. After that we determined the resulting components within individual sets. In the first set (arguments for the use of ICT), we identified information, time, space and relationship components. Despite the implied critical relationship towards the use of ICT, the need for its use in the process of cooperation and partnership with parents was clearly shown, because ICT is nowadays an urgency. In the second set (arguments against the use of ICT), considering the answers, we have defined information, technological, human and relationship components. The common thread in this set was mainly related to personal contact and lack of trust in a relationship.

The analysis of results did not stop only in bare comparison of arguments for and against, but further on, using a qualitative SWOT analysis, various components were put up against one another, allowing us to better capture and understand the presented possibilities and solutions for better integration of ICT in the process of cooperation and partnership with parents.

The following are examples of two posters out of eleven. While poster 1 uses an approach through strengths-weaknesses in using ICT in collaboration with parents, in poster 2, the use of ICT in collaboration with parents is presented through various options. Analysing the first poster is easier since students have already made sense of the content, although it later turns out that opportunities and dangers have been designated only to internal elements (weaknesses). The students wrote down an example of this as a disadvantage: "ITC cannot determine the importance of information." SWOT analysis showed that this example should be allocated as danger and an external element. We inserted the contents of the posters into Table 1 for easy review: We got an overview of the proposed type of ICT, the proposed programs or application, other services, and added the explanation. Of course, this is only a matter of technical data, which can help answer the second goal.

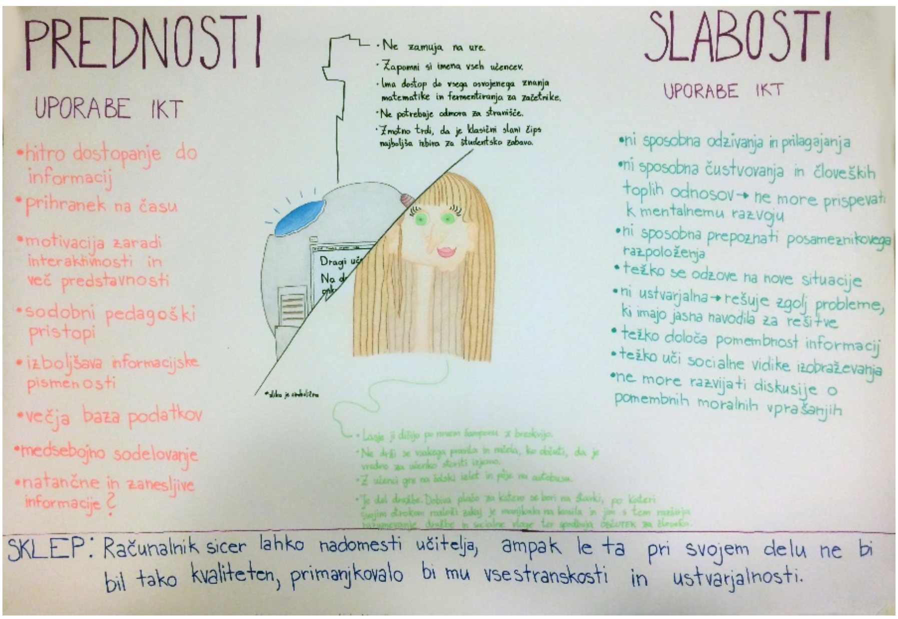

Figure 5: Poster 1 -Advantages and disadvantages of using ICT in collaboration with parents
Source: Own.

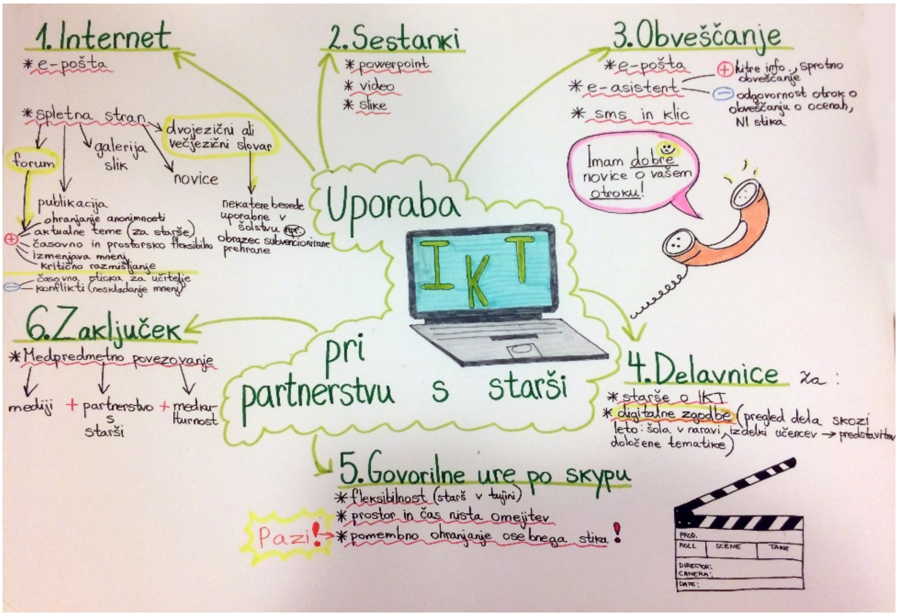

Figure 6: Poster 2 -Using ICT in partnership with parents

Source: Own.

Table 1: Suggestions for using ICT in collaboration with parents with an explanation

Type of ICT	Program / Application / Service / Other	Explanations
Computer/ tablet	email (6x) service	– Notifications. – A shared email address for parents. – Weekend message (last week event renewal).
	School website (6x) A platform that provides information	– Parents can enter an e-calendar through the application. – Login with username and password. – Emergency notifications about the cancellation of a sports day. (2x) – Access to various documents (e-materials, the schedule, menu, publication). (3x) – Access to some useful forms (e.g. subsidized food form).

		– Photo gallery. (3x) – Notice of absence (first and last name, class, reason for absence, contact number). – FAQ. – Bilingual or multilingual dictionary. – Notification. – Websites of good books, parenting magazines. – Regular updating of the school website.

	Skype (6x)
	
	program
		– A lecture via Skype. (2x)
		– Introducing your child to kindergarten.
		– Parent teacher meetings (3x):
		    – Flexibility (e.g. when one parent is abroad).
		    – Space and time are no limit.
		– Maintain personal contact.

	eAsistent (5x), Lo.Polis, EviWeb service, web portals	– Notifications. – Computer courses for parents to use an e-assistant. – E-look (parents' insight into children's grades).
	Ppt (5x) Computer program	– Use of PowerPoints at parent-teacher meetings, lectures and workshops for parents. (2x) – Computer courses for parents to use ppt.
	Forums, chat rooms (4x)	– Exchange of views, discussions between parents and teachers. – Participation of experts.
	Movie, video (2x)	– Parent-teacher meetings. – To present cultures.
	Digital stories (2x)	Review of work throughout the year: – School in nature. – Student Products - Presentation of a specific topic.
	World Wide Web "Friendly Internet"	– Google (browser). – Online (anonymous) surveys. – Facebook (social network). – Parental blog.

		– Security.
	Interactive whiteboard	
	Electronic course material	
	Computer Games (2x)	– Suggestions for parents about appropriate and instructive computer games for children.
	Workshops	– Informing parents about the use of ICT.
Telephone	Call (3x)	– Parents could call teachers on a mobile phone within the agreed hours.
	SMS (2x)	– Notifications.
	Survey	– For parents.
	School smartphone app	–
TV / DVD player	Movie (2x)	– Parent-teacher meetings. (2x)
	TV Screen	– In the lobby with school announcements and updates (2x).
Radio		– Connection to local radio.
Web camera		– If one of the parents cannot attend the parenting meetings for any reason, we offer them a videoconference.
		– Recordings of children during school activities. We provide the recordings to parents.
		– Recording lessons.

Table 1 lists the types of ICT proposed by students, the second column mentions programs and applications, and the third provides the explanation. Some answers have repeatedly appeared on various posters, which is shown by the numerical frequency in the brackets. Table 1 shows that students do not propose different ways of interacting with their parents through ICT than those already existed. We can conclude that they derive from their own experience, although they focused solely on the Slovenian territory and did not focus on good practices abroad. The most common platform in collaboration with parents is using a website, to which they have added the broadest explanation. Based on the contents of Table 1, we cannot conclude what attitude towards the use of ICT in cooperation with parents is reflected in the proposals of students, as one might mistakenly think that students are only in favour of using ICT in cooperation with parents, which is not true. Only a more detailed SWOT analysis of the poster results gives us a more complex view.

Table 1 lists only technical resources, programs, applications, and as explanations of individual content.

Table 2: First set components (arguments for the use of ICT)

Information	Time
– Quickly and easily accessible information (4x). – Exchange of information among parents. – Exchange of information literacy. – Several parents can be informed at a time. – Precise and reliable information. – Bigger and more transparent database. – Guaranteed anonymity on forums.	– Saves time (3s). – Time flexibility. – Regular updating.
Spatial	**Relationship**
– Space is not restriction. – Spatial flexibility.	– Facilitates mutual cooperation (parents–teacher). – Motivation of pupils to learn due to cooperation of parents with school. – Greater motivation of parents due to interactivity and multimedia.

As can be seen from Table 2, the majority of the arguments for the use of ICT in cooperation and partnership with parents can be found within the information component, where speed and accessibility of information appear most often. The advantages also relate to the integration among parents with easier and simultaneous provision of information, precision, reliability and creation of a transparent database and information literacy of everyone included. As for other components, three arguments are given in the time and relationship components and two arguments appear in the space component. Saved time is for students one of the key arguments for the use of ICT, which could also be connected to time flexibility. The spatial component is related to this as well, because space does not represent any restriction, and this correlates with saved time. In the opinion of students, ICT can additionally increase the motivation of parents because of interactivity and multimedia, and strengthened mutual cooperation may have a positive impact on the motivation of pupils to learn. This is exactly what Passey (2011) and Harris and Goodall (2007) pointed out in their research. The reasons listed by students do not differ from the ones already presented by Dečman Dobrnjič and Černetič (2009) in their research.

Table 3: Second set components (arguments against the use of ICT)

Information	Technological
– Difficulties in determining the relevance of information. – Lack of appropriate material.	– Insufficient equipment of schools. – Computer literacy competences are not clearly and formally defined. – Not everyone has a smart phone/computer. – Possibility of network or machine defects. – Not creative -resolves only those problems, which have clear instructions for solutions.
Human (competence component)	**Relationship**
– Does not properly teach the social aspects of education. – Cannot develop the discussion on more relevant moral issues. – Insufficient qualification for use. – Some individuals do not regularly open their e-mails.	– No direct personal contact. – Not capable of having emotions and warm human relations -cannot contribute to mental development. – Not capable of reacting and adjusting. – Responsibility of children to inform parents about grades, no contact. – Not capable of recognizing an individual's mood. – Does not easily respond to new situations.

Considering the answers provided, two components stand out in Table 3 and they were already shown in the first set (information and relationship), while two new ones appear (technological and human, or competence). The arguments against the use of ICT in cooperation and partnership with parents appear to the highest degree in the relationship component, which can be defined as one of the key reasons which do not support the use of ICT alone in the process of cooperation. Insufficient personal contact, absence of emotions, responsiveness and adaptation also appear as reasons against the use of ICT in the research by Dečman Dobrnjič and Černetič (2009). At first sight, the relationship component is related to the human component, but it refers to competences of participants. This means that the person involved must possess certain skills, if they want to develop partnership on the one side and apply ICT as a resource in cooperation and partnership on the other. The fact that institutions and also homes are not sufficiently equipped with ICT may be the next reason, which falls into the technological component. Of course, despite the general focus in schooling and education towards improving the computer, technological and digital literacy, not everyone has appropriate ICT or related applications, and this represents an obstacle in the flow of information. ICT is subject to various defects and must have constant technological support, because technology itself cannot assess the importance of information and still needs a human operator.

By confronting the reasons for and against, the students mainly displayed criticism in the use of ICT in cooperation and partnership with parents, which is mainly shown in the emphases on the relationship component and human factor or direct human contact, which must, in the future, also represent the foundation from which trust as the foundation of every relationship grows. The answers, despite being in favour of the use of ICT in the process of cooperation and partnership with parents, suggest that ICT cannot substitute mutual and direct contact; it merely represents an instrument that must be properly utilized by everyone involved. Accordingly, we can refer to Figure 1, which defines that use of ICT in cooperation between a school and home is reasonable, reliable and manageable only upon simultaneous functioning of all three parts between students, parents and a school. These arguments were analysed with the SWOT analysis, including some aspects of the use of individual web options for communication shown in Table 4 below.

Table 4: SWOT analysis of components

	ADVANTAGES	WEAKNESSES
INTERNAL ELEMENTS	**Information component (+):** – Quickly and easily accessible information. – Exchange of information among parents. – Accurate and reliable information. – Guaranteed anonymity on forums.	**Human component – competences (-):** – Not creative -resolves only problems which have clear instructions for solutions. – It does not teach social aspects of education. – Cannot develop the discussion on more relevant moral issues. – Insufficient qualification for use. – Some do not regularly open their e-mails.
	Time component (+): – Saves time. – Time flexibility.	**Technological component (-):** – Insufficient equipment in schools. – Computer literacy competences are not clearly and formally defined. – Not everyone has a smart phone/ computer. – Possibility of network or machine defects.
	Spatial component (+): – Space is not a restriction. – Spatial flexibility.	**Relationship component (-):** – No direct personal contact. – Not capable of having emotions and warm human relations, cannot contribute to mental development. – Not capable of reacting and adjusting. – Not capable of recognizing an individual's mood. – Does not easily respond to new situations. –

	Relationship component (+): – Increase mutual cooperation (parents–teacher).	**Information component (-):** – Lack of appropriate material.
	OPPORTUNITIES	**THREATS**
EXTERNAL ELEMENTS	**Information component (+):** – Improvement of information literacy. – Bigger and more transparent database. – Presentation of current topics for parents within a forum. – Exchange of opinions within a forum. – Encouraging critical thinking.	**Relationship component (-):** – Responsibility of children to inform parents about grades, no contact. – Conflicts (contradictory opinions) within a forum.
	Time component (+): – Regular updating.	**Information component (-):** – Difficulties in determining the relevance of information.
	Relationship component (+): – Motivation of pupils to learn due to cooperation of parents with school. – Greater motivation of parents due to interactivity and multimedia.	

If we analyse the arguments from Tables 2 and 3 using the SWOT analysis, we get a completely different image of the understanding of the use of ICT in cooperation and partnership with parents. Of course, the reasons for the use of ICT are still understood as positive, but we have divided them into advantages and opportunities, while the arguments (also within the same components) against the use of ICT were classified as either weaknesses or threats. This way we can see when ICT can be understood as an opportunity and when as a threat; it is worth noting that the above table was based only on answers of students, and it would be much more accurate following a more extensive and in-depth analysis.

While the advantages and weaknesses were defined and mentioned in interpretations of Tables 2 and 3, the content in Table 4 also provides an insight into opportunities and threats. Three components from set 1 (arguments for the use of ICT) can be defined as opportunities, with arguments from the information component again accounting for the most numerous ones. Some of the most significant opportunities provided by ICT in cooperation and partnership are information literacy, clear database and increased motivation of pupils to learn due to cooperation of parents with school. The last argument is also mentioned by Epstein (2001), Harris and Goodall (2007), and Passey (2011), because the activation of the inclusion of parents in an educational institution is one of the foundations for a partnership with school and is also greatly linked to pupils' achievements.

The threat column is of course connected to the diagram of cooperation between a school and parents (Figure 4), which suggests that all participants must cooperate with one another, otherwise the use of ICT in the process of cooperation and partnership does not make any sense. Students specifically pointed out the responsibility of children to inform parents on any relevant information, which is related to the dialogue and relationship between parents and a child.

Conclusion

The aim of the research was to establish how students understand cooperation with parents, what possibilities of cooperation with parents by means of the use of ICT they suggest, what attitude towards the use of ICT in cooperation with parents is shown in suggestions, and what ICT resources and applications they know. Throughout the research, there has actually been a critical attitude towards the use of ICT, although the students stated a relatively equal number of arguments for as well as against the use of ICT in cooperation and partnership with parents. The students see cooperation with parents through conventional forms of cooperation, listing the following ICT resources for the process of cooperation and partnership: the computer/tablet, smartphone, webcam, TV, radio, and also any program, application or other service provided by each type. In this context, they mentioned communication by e-mail, through websites, Skype, eAsistent, forums and chat rooms, the Lo.Polis and EviWeb school portals. Most often they mentioned the fact that parents are timely informed on and have facilitated access to certain documents and other important information, (such as, schedules, e-calendars, menus, publications, galleries, photos, e-grade books). As can be seen from the presentation, students are familiarized with the methods of cooperation as well as ICT resources, but it still makes us wonder whether given suggestions are connected to the actual situation. Nevertheless, they suggested the following solutions -some already existing, some new: (1) greater provision of (free) computer courses for parents to improve their digital literacy; (2) activation of the triadic digital form of cooperation: pupils -parents -teachers; (3) translation of all digital contents related to the institution into various foreign languages; (4) introduction of a child to a kindergarten via Skype; (5) parent-teacher conferences via Skype; (6) introduction of the electronic signature; (7) setting up applications for scanning tests for parents, enrolling/removing a child into/from activities, reporting absence, child's choice.

A significant emphasis of the given research mainly lies in the identification of various components, which are combined in the information, time, spatial and relationship component in the first set (arguments for the use of ICT), and in the information, technological, human (competence) and relationship component in the second set (arguments against the use of ICT). The SWOT analysis has shown that such an overview is important, otherwise opportunities and threats can be confused with advantages and weaknesses.

Even though the analysis due to a limited number of persons included in the research cannot offer an in-depth insight, it still suffices for further discussion. However, this opens up questions regarding the actual situation, which is connected to computer literacy of parents and educational workers. Certainly, a clear distinction between various types of literacy (information, digital and media) would not hurt either. The key factors may also be the cultural and economic capital of the family and material inequality with regard to the access to ICT.

Even though a critical approach in the use of ICT was implied, we should not forget the co-dependence and mutual activity of individual players (Figure 4), which puts the child at the centre, both in Epstein's diagram (Figure 1) and Bronfenbrenner's ecological theory (Figure 2). Only then can we justify the relevance of the use of ICT in cooperation and partnership with parents.

References

Anastasiades, P., & Zaranis, N. (Eds.). (2017). *Research on e-Learning and ICT in education. Technological, pedagogical and instructional perspectives.* Springer International Publishing. https://doi.org/10.1007/978-3-319-34127-9

Brečko, B. N. (2016). Spremenjene pedagoške prakse z uporabo IKT [Altered pedagogical practices through ICT use]. *Andragoška spoznanja*, *22*(4), 43–56.

Bronfenbrenner, U. (1994). Ecological models of human development. *Readings on the development of children, 2*(1), 37–43.

https://edfa2402resources.yolasite.com/resources/Ecological %20Models %20of %20Human %20Development.pdf

Dečman Dobrnjič, O., & Černetič, M. (2009, April 15–18). *Uvajanje IKT pri sodelovanju s starši* [Introducing ICT in collaboration with parents; Paper Presentation]. Mednarodna konferenca Splet izobraževanja in raziskovanja z ICT. https://skupnost.sio.si/sio_arhiv/sirikt/www.sirikt.si/fileadmin/sirikt/predstavitve/2009/Uvanjanje_IKT_pri_sodelovanju_z_starsi-Dobrnjic.pdf

Epstein, J. L. (2001). *School, family and community partnerships*. Boulder, CO: Westview Press. https://www.govinfo.gov/content/pkg/ERIC-ED467082/pdf/ERIC-ED467082.pdf

Epstein, J. L. (2018). *School, family, and community partnerships: Preparing educators and improving schools*. Routledge. https://doi.org/10.4324/9780429494673

Gavriloski, M., Lepičnik Vodopivec, J., & Hmelak, M. (2018). Mnenja bodočih vzgojiteljic in vzgojiteljev o uporabi ICT v vrtcu [Opinions of future early childhood teachers about the use of ICT in kindergartens]. In T. Štemberger, S. Čotar Konrad, S. Rutar, A. Žakelj, M. Valenčič Zuljan, D. Zuljan & A. Ježovnik (Eds.), *Oblikovanje inovativnih učnih okolij* [Constructing innovative learning environments] (pp. 151–161). Koper: Založba Univerze na Primorskem.

Harris, A., & Goodall, J. (2007). *Engaging parents in raising achievement: Do parents know they matter? DCSF research report RW004 from a research project commissioned by the Specialist Schools and Academies Trust.* London: Department for Children, Schools and Families. https://dera.ioe.ac.uk/6639/1/DCSF-RW004.pdf

Hornby, G. (2011). *Parental involvement in childhood education: Building effective school-family partnerships*. Springer Science & Business Media. https://doi.org/10.1007/978-1-4419-8379-4

Jeynes, W. H. (2005). A meta-analysis of the relation of parental involvement to urban elementary school student academic achievement. *Urban Education, 40*(3), 237–269. https://doi.org/10.1177/0042085905274540

Jeynes, W. H. (2007). The relation between parental involvement and urban secondary school student academic achievement: A meta-analysis. *Urban Education, 42*(1), 82–110. https://doi.org/10.1177/0042085906293818

Kroflič, R. (2001). *Otrok v vrtcu: priročnik h kurikulu za vrtce* [A child in the kindergarten: A handbook for kindergarten curriculum]. Maribor: Obzorja.

Lamovec, T. (1993). *Spretnosti v medosebnih odnosih* [Skills in interpersonal relationships]. Ljubljana: Center za psihodiagnostična sredstva.

Lepičnik Vodopivec, J. (2012). *Teorija in praksa sodelovanja s starši: priročnik* [Theory and practice of collaborating with parents: A handbook]. Pedagoška fakulteta Univerze v Ljubljani.

Marjanovič Umek, L., & Zupančič, M. (2009). Teorije psihičnega razvoja [Theories of psychological development]. In L. Marjanovič Umek & M. Zupančič (Ed.), *Razvojna psihologija* (pp. 28–63). Ljubljana: Znanstvenoraziskovalni inštitut Filozofske fakultete.

Martin, A., & Grudziecki, J. (2006). DigEuLit: Concepts and tools for digital literacy development. *Innovation in Teaching and Learning in Information and Computer Sciences*, *5*(4), 1–19. https://doi.org/10.11120/ital.2006.05040249

Passey, D. (2011). Technologies involving parents and guardians with their children's learning. In A. Méndez-Vilas (Ed.), *Education in a technological world: Communicating current and emerging research and technological efforts* (pp. 467–477). Formatex Research Center. http://www.research.lancs.ac.uk/portal/files/39516835/Technologies_involving_Parents_Passey.pdf

Rhodes (2013). *Developmental theories*. Weebly. http://msnaeemsclass.weebly.com/developmental-theories.html

Somekh, B. (2007). *Pedagogy and Learning with ICT. Researching the art of innovation*. London: New York: Routledge. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.463.953&rep=rep1&type=pdf

Vec, T. (2002). Dejavniki učinkovite komunikacije in komunikacijski zakoni [Efficient communication, its rules and components]. *Socialna pedagogika*, *6*(1), 69–82.

Vitoulis, M. (2017). The formation of pre-service early childhood educators' perceptions about ICT use in early childhood education after an experiential approach. *European Journal of Education Studies*, *3*(5), 22–37. https://doi.org/10.5281/zenodo.439103

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Planned Mathematical Activities in Slovenian Kindergartens

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Abstract This study aimed to explore the manifestation of planned mathematical activities in Slovenian kindergartens. The study is based on the analysis of the reports written by the third-year full-time students (n = 57) of the study program Pre-school Education after completing their integrated practical training in various Slovenian kindergartens. An analysis of the reports showed that during the integrated practical training, which included students' 4 full-day visits in kindergartens, a total of 74 planned mathematical activities were carried out by their mentors. As many as 19.3 % of students did not experience a single planned mathematical activity during their practical training. Activities in arithmetic (41.9 %) and geometry (27.0 %) predominated, while there were much fewer activities related to measurement (13.5 %) and the so-called "other content" area (12.2 %). Activities related to algebra were performed the least (only 5.4 %). The average number of mathematical activities performed in the groups of children aged 1–3 years was much lower (M = 1.00) than the average number of mathematical activities performed in the groups of children aged 4–6 years (M = 1.34) and in the mixedage groups (M = 1.41), but the difference is not statistically significant.

Keywords: early mathematics, early childhood education, practical training, mathematics areas, preschool educators.

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Over the years, after discussing their practical training experiences with pre-service kindergarten teachers and focusing on mathematical activities they had observed in kindergartens, the feedbacks often indicated that mathematics is not as present as other areas of the curriculum. Slovenian Curriculum for kindergartens (Kurikulum za vrtce, 1999) defines six content areas as follows: movement, language, art, society, nature and mathematics. However, the practice is oriented towards the holistic approach to teaching and learning (Marentič Požarnik, 2003, p. 120), and as such, activities in kindergarten strive to blur the boundaries between the areas as much as possible. Nevertheless, recent research findings suggest that the integration of different content areas in Slovenian kindergartens is still far from desired (for example, Antolin Drešar, 2017b). Moreover, in recent research, Antolin Drešar (2017a) examined how future kindergarten teachers perceive the integration of mathematics and other areas of the curriculum during their practical training in kindergartens and found that the integration of mathematics with natural science was perceived the most often, while integration with art was the least perceived among all pairs of possible links. The growing body of research is demonstrating that mathematical skills acquired by children in kindergarten are the best predictor of later academic success for both boys and girls, regardless of their socioeconomic background (see Claessens et al., 2009; Claessens & Engel, 2013; Geary et al., 2013; Ritchie & Bates, 2013). However, according to Ginsburg (2009) and Hachey (2013), the intuitive mathematical skills that children develop naturally are not enough. The US National Research Council (2009) also stresses that early years teaching must be intentional. Despite strong evidence of the importance of early mathematics, many studies have suggested that decidedly limited mathematics is taught in the early years (Bruce et al., 2016; Clements & Sarama, 2007; Hachey, 2013; Lee & Ginsburg, 2007). Phillips et al. (2009), for example, reported that American early-years educators devote a much smaller proportion of the day to mathematical activities compared to literacy and social studies activities.

The research review on pre-school mathematics education in the Slovenian educational environment pointed out research conducted by Nudl et al. (2012); the study examined the amount of mathematical activities in which Slovenian kindergarten children were engaged. The analysis of diaries of mathematical activities written by 130 pre-service kindergarten teachers during their integrated practical training in kindergarten revealed a total of 800 different types of mathematical activities. At first glance, the number seems to be high, but if one considers that each pre-service kindergarten teacher observed a selected child and recorded each mathematical activity in which the child was engaged, results show that on average, one child participated in 6 mathematical activities in about half a year. However, the total number of mathematical activities may even be overestimated, since it encompasses planned mathematical activities and short, spontaneous activities, such as playing with blocks. In this context, Tepylo et al. (2015) argue that not every playtime activity incorporating blocks can be considered as mathematics-related, even though early years teachers might perceive it as such. Indeed, children may use the blocks in imaginative play or in some other way where they do not focus on the mathematical ideas implicit in the blocks.

Mathematical Content Areas in Kindergarten

Early childhood mathematics education can be very broad and could include a comprehensive collection of mathematical activities covering various mathematical content areas such as arithmetic, algebra, geometry, measurement and the so-called "other content" area. However, the literature review indicates that early teaching and learning of mathematics is often limited to very basic content such as counting (e.g. Bargagliotti et al., 2009; Ginsburg et al., 2008; Nudl et al., 2012; Rudd et al., 2008). According to Reys et al. (2008), kindergarten mathematics standards and practice in kindergarten classes emphasize early numeracy skills over more advanced mathematics skills. In addition, Engel et al. (2013) reported that teachers devoted the most mathematics time to basic counting and recognition of simple geometric shapes, although the vast majority of children mastered this already when they entered kindergarten. One study in the US, in which more than 400 early child care providers answered questions about their main mathematics activities, showed that 67 % of them chose counting, 60 % sorting, 51 % recognizing numbers, 46 % patterning, 34 % number concepts, 32 % spatial relations, 16 % creating shapes, and 14 % measuring (Sarama, 2002). As this study shows, geometry and measuring were the least popular. Similar findings are reported by Nudl et al. (2012) on the representation of mathematical activities in Slovenian kindergartens, which indicates that geometry and measuring activities were performed least often. Clements and Sarama (2007) also reported that geometry and spatial thinking are often ignored or minimized in early education.

Multiple reasons may contribute to the imbalance of content areas. According to Lee and Ginsburg (2007), teachers of young children often underestimate children's interests and abilities and assume that simple concrete concepts such as counting with small numbers is the maximum of the children's capabilities. Moreover, Lee and Ginsburg (2007) also pointed out that early childhood educators do not believe that young children can handle abstract ideas and that they are not ready for various mathematical topics. Consequently, early mathematics is narrowed to basic counting and shapes (Ginsburg et al., 2008). Another reason for focusing on "simple" mathematics may be that kindergarten teachers vary in their understanding of and feelings about efficacy in teaching early mathematics (Copley, 2004; Ginsburg et al., 2008; Greenfield et al., 2009).

Current Study

The study presented in this paper focuses on planned mathematical activities. As mentioned in the beginning, discussions with students after their practical training often pointed to the lack of mathematical activities performed in kindergartens. Accordingly, the main objective of the study was to explore the manifestation of planned mathematical activities in Slovenian kindergartens and thus contribute to getting a better insight into the amount of mathematics that is taught in Slovenian kindergarten classrooms. Furthermore, the aim of the study was to investigate the representation of planned mathematical activities in content areas to see how balanced the content areas are in Slovenian kindergartens.

Method

The study is based on the analysis of written reports submitted by 57 third-year full-time students of the study program Pre-School Education at the University of Maribor, in the academic year 2016/2017, after completing their integrated practical training in various kindergartens throughout Slovenia. The practical training is an important part of the education of future pre-school teachers and is incorporated in all three years of the study program. Part of the practical training is implemented as an integrated practical training and is carried out in each year of the program. As part of the integrated practical training, each student goes to kindergarten one day a week to gain valuable teaching experience by systematically observing various aspects of the educational work. In the academic year of 2016/2017, the integrated practical training encompassed students' four full-day visits in kindergarten. In the framework of Mathematics Education (the course is held in the last semester of the study program) the students are instructed to observe mathematical activities that take place during the integrated practical training. For the purposes of this research, students had to submit reports in which they were required to indicate all planned mathematical activities that were carried out by their mentor. In addition, they had to provide short descriptions of the activities and define the mathematical content area of performed activities.

57 participating students carried out their integrated practical training in 44 different kindergartens in different regions of Slovenia. As Table 1 shows, the majority of students carried out their integrated practical training in the Slovenian Styria region (68.19 %), followed by the Mura region (25.0 %) and three other regions. It should be noted that the majority of students come from Slovenian Styria, where the faculty is located, but some students come from more remote regions such as Upper Carniola, and Coastal-Karst. In recent years, students have been given the opportunity to do their integrated practical training in their home towns, but on the base of the data on kindergartens, it can be concluded that especially those who are very remote did not choose this option and preferred to pursue the integrated practical training practice in the vicinity of the faculty.

Table 1: Frequencies (f) and relative frequencies (f %) of kindergartens in which pre-service kindergarten teachers completed their integrated practical training regarding regions of Slovenia

Regions	*f*	*f* %
Slovenian Styria	30	68.19
Mura	11	25.0
Carinthia	1	2.27
Central Sava	1	2.27
Southeast Slovenia	1	2.27
Total	44	100.00

Most of the participating students carried out the integrated practical training in the senior kindergarten age group (50.9 %), 19.3 % in the younger age group and 29.8 % in the mixed-age classes. Regarding the location of the kindergartens, the majority of students completed their practical training in urban kindergartens (54.4 %), while the rest of them attended practical training in rural and suburban kindergartens (45.6

%). The final reports of the students on integrated practical training were analysed, as they represent a rich source of information on mathematics that is taught in Slovenian kindergartens. Students' reports were thoroughly reviewed and all the planned mathematical activities listed in the students' reports outlined. Students were explicitly instructed to follow the planned mathematical activities. The review of the reports revealed that they followed the instructions and did not include spontaneous mathematical activities (such as counting in the morning circle) in their records. Given the short description of the activities, it was checked whether students properly defined the content area of each mathematical activity and modified if necessary. Table 2 shows some specific examples from the students' reports that illustrate correctly defined content areas.

Table 2: Examples of planned mathematical activities that were listed in students' reports and properly defined content areas

Age group	Mathematical activity	Short description	Properly defined content area
3–6 years (mixed age group)	Dots for ladybugs	The teacher read a fairy tale titled Dotless Ladybugs. She made paper ladybirds with 7 outlined but blank dots. She prepared a black stamp and a larger dice. The child came to the centre of the circle, rolled the dice, recognized the number of dots and printed with the stamp as many dots as had fallen on the dice. The next one had to think about how many dots were missing so that the ladybug would have 7 dots.	Arithmetic
5–6 years (senior age group)	Colors of the T-shirts	Children sat in a circle and looked at the colors of their T-shirts. Each child had to say what color his T-shirt was, and then he got a small sheet with the matching color. If the child had a colorful or striped T-shirt, the kindergarten teacher drew lines on his or her sheet. Then they made a bar chart on the floor using their color sheets. They discussed how many children had red T-shirts, how many yellow T-shirts, etc.	"other content" area
1–2 years old (younger age group)	Measuring and baking	The kindergarten teacher showed the children how to measure the ingredients for bread with cups and spoons (e.g. 4 cups of flour, 2 cups of water, 3 teaspoons of salt).	Measurement

In Table 3 we can see a few examples of mathematical activities where students have not defined the content areas adequately. In these cases, they have been corrected as is illustrated below.

Table 3: Illustration of planned mathematical activities where the content areas were inadequately defined and needed to be corrected

Age group	Mathematical activity	Short description	Inadequately defined content area	Properly defined content area
2–3 years old (younger age group)	Creating symmetry	The kindergarten teacher presented the children with an A3 size sheet. She folded the sheet and asked them if the sheet was the same. Then she invited them to create symmetry. The children used the folded A3 sheet and painted something on one half, which was then printed on the other half to create symmetrical pictures.	Algebra	Geometry
5–6 years (senior age group)	Ludo with the big dice	Children played the board game Ludo, but in a slightly different way than usual. Instead of using normal dice, the kindergarten teacher prepared large dice with dots arranged in patterns that can be found on subitizing dot cards.	Numbers	Arithmetic
3–5 years (mixed age group)	Making a house using shapes	The children first cut out shapes and then they made a house from these shapes (squares, triangles and rectangles). Then they built houses using paper strips of different lengths and thicknesses.	Shapes	Geometry

After all students' reports were reviewed and content areas modified if necessary, the data was processed using the SPSS program for data processing and analysis.

Results

The results of this study are presented in three parts. The first part reports on the findings that relate to the amount of performed planned mathematical activities in Slovenian kindergartens. The second part presents the results on the manifestation of the planned mathematical activities among different age groups of children. The last part of the results relates to the representation of different mathematical content areas among the planned mathematical activities performed by Slovenian kindergarten teachers.

Performed planned mathematical activities

The results showed that during the integrated practical training 57 students recorded a total of 74 planned mathematical activities carried out by their mentors. The result, therefore, indicates that during the students' four full-day kindergarten visits, the kindergarten teachers, on average, carried out one planned mathematical activity (M = 1.30). Table 4 shows that in no cases the number of planned activities carried out by early childhood educators exceeded the number of 3 (14.0 % of pre-service teachers reported 3 planned mathematical activities to be performed during their integral practice in the kindergarten). The largest proportion of students (45.6 %) detected only one planned mathematical activity during their practical training, while 21.1 % of students recorded two planned mathematical activities. The most striking result was that as many as 19.3 % of students did not see a single planned mathematical activity during their practical training.

Table 4: Frequencies (f) and relative frequencies (f %) of performed planned mathematical activities reported by pre-service kindergarten teachers

Number of activities	*f*	*f* %
0 activities	11	19.3
1 activity	26	45.6
2 activities	12	21.1
3 activities	8	14.0
Total	57	100.0

Note. A total of 74 planned mathematical activities were reported.

Planned mathematical activities among different age groups of children

This study focused on the manifestation of planned mathematical activities among different age groups of children.

Table 5: Frequencies (f) and relative frequencies (f %) of performed planned mathematical activities reported by pre-service kindergarten teachers among different age groups of children

Number of activities	Children aged 1–3 years		Children aged 4–6 years		Mixed age group		Total	
	f	*f* %	*f*	*f* %	*f*	*f* %	*f*	*f* %
0	3	27.3	6	20.7	2	11.8	11	19.3
1	6	54.5	11	37.9	9	52.9	26	45.6
2	1	9.1	8	27.6	3	17.6	12	21.1
3	1	9.1	4	13.8	3	17.6	8	14.0
Total	11	100.0	29	100.0	17	100.0	57	100.0

The study showed that as many as 27.3 % of pre-service kindergarten teachers reported that they did not observe a single planned mathematical activity in the group of youngest children aged 1–3 years. If this is somehow understandable in the youngest group, it is quite surprising that more than one-fifth of the participating pre-service kindergarten teachers (20.7 %) found that no mathematical activity was performed in the group of the senior kindergarten children. In all groups of children, regardless of the age of the children, pre-service kindergarten teachers most frequently recorded 1 planned mathematical activity to be performed during their integral practice in the kindergarten. Two planned mathematical activities most frequently occurred in the group of senior kindergarten children (reported by 27.6 % of pre-service kindergarten teachers), while three planned mathematical activities were most frequently observed in the mixed age group (17.6 %) (see Table 5).

Table 6: Arithmetic means of planned mathematical activities performed in different age groups of children

Age group	Mean	*N*	Std. Deviation
Group of children aged 1–3 years	1.00	11	0.894
Group of children aged 4–6 years	1.34	29	0.974
Mix age group	1.41	17	0.939
Total	1.30	57	0.944

$F = 0.699$; $p = .501$

As Table 6 shows, the average number of mathematical activities performed in the groups of children aged 1–3 years was much lower (M = 1.00) than the average number of mathematical activities performed in the groups of children aged 4–6 years (M = 1.34) and in the mixed-age groups (M = 1.41). However, the difference is not statistically significant (F = 0.699; p = .501).

Regarding the location of the kindergartens (see Table 7), this study revealed that the average of planned mathematical activities performed was slightly higher in rural and suburban kindergartens (M = 1.31) than in urban kindergartens (1.29), but the difference is not statistically significant (F = 0.241; p = .787).

Table 7: Arithmetic means of planned mathematical activities performed regarding the location of kindergartens

Location of the kindergarten	Mean	*N*	Std. Deviation
Rural and suburban kindergartens	1.31	26	0.788
Urban kindergartens	1.29	31	1.071
Total	1.30	57	0.944

F = 0.241; p = .787

Planned mathematical activities regarding content areas

This research was focused on the manifestation of the planned mathematical activities, as well as representation of the individual mathematical content areas.

Table 8: Frequencies (f) and relative frequencies (f %) of performed planned mathematical activities regarding different mathematical content areas

Content area	*f*	*f* %
Arithmetic	31	41,9
Algebra	4	5,4
Measurement	10	13,5
Geometry	20	27,0
“Other content” area	9	12,2
Total	74	100,0

As shown in Table 8, the results indicate that in terms of mathematics content areas, arithmetic activities prevailed (41.9 %), followed by activities associated with geometry (27.0 %). The activities related to measurement (13.5 %) and "other content" area (12.2 %) were performed to a much lesser extent. Activities in the field of algebra were most rarely conducted (only 5.4 %).

The study further focused on the manifestation of planned mathematical activities in different age groups regarding mathematical content areas.

Table 9: Arithmetic means of planned mathematical activities performed in different age groups regarding mathematical content areas

Age group		Arithmetic	Algebra	Measurement	Geometry	"Other content" area
Children aged 1–3 years	Mean	0.45	0.00	0.00	0.45	0.09
	Std. Dev.	0.522	0.000	0.000	0.688	0.302
Children aged 4–6 years	Mean	0.48	0.07	0.28	0.34	0.17
	Std. Dev.	0.634	0.258	0.528	0.553	0.384
Mixed age group	Mean	0.65	0.12	0.12	0.29	0.18
	Std. Dev.	0.702	0.332	0.332	0.470	0.393
Total	Mean	0.53	0.07	0.18	0.35	0.16
	Std. Dev.	0.630	0.258	0.428	0.551	0.368

This research indicates that in the groups of the youngest children (aged 1-3 years) no activity in the field of algebra or measurement was performed (see Table 9). The most frequently performed planned mathematical activities in the groups of children aged 1–3 years were activities in the field of arithmetic (M = 0.45) and geometry (M = 0.45).

The highest average of performed arithmetic activities was observed in the mixed age groups of children (*M* = 0.65). Since algebra is often considered to be one of the most challenging contents, activities related to algebra would be expected to be most often performed in the group of older children, but our results show otherwise. In the mixed age groups, the average number of activities related to algebra was higher (*M* = 0.12) than in the group of the oldest children (*M* = 0.07). Moreover, measuring activities were most often performed in a group of older children (*M* = 0.28).

Discussion and Conclusion

The results of this research confirmed the assumption that arose based on annual discussions with prospective kindergarten teachers regarding their observations of the lack of mathematical activities in Slovenian kindergartens. Thus, the findings indicate that there are relatively few planned mathematical activities. Most pre-service kindergarten teachers reported that only one planned mathematical activity had been performed during their integrated practical training. However, the most worrying is the finding that nearly one-fifth of all prospective kindergarten teachers did not see a single planned math activity during their integral practice. It should be noted that the participating kindergartens were informed about the purpose of students' integral practice and that students previously disclosed with their mentors that they were instructed to specifically observe and record planned mathematical activities. From this point of view, it would be expected that, as a result, kindergarten teachers might show more engagement and therefore perform more planned mathematical activities than they would otherwise. Where to look for reasons? The analysis of students' reports that reflected students' experiences and feelings regarding practical training might reveal at least a few of them. For example, Ana wrote: *"Already at the beginning of practical training, my mentor told me that she was quite weak in mathematics so she was very glad when I shared with her some ideas and activities we learned in Mathematics Education."* A similar reason was reported in the study conducted by Ginsburg et al. (2001), who stated that early childhood educators may not feel comfortable or competent enough to teach mathematics. On the other hand, Ginsburg et al. (2008, p. 10) noted that "most early childhood teachers do not place a high value on teaching mathematics." In our research, quite a few pre-service teachers expressed their disappointment regarding the modest amount of planned mathematical activities. According to their observations, some teachers do not carry out planned mathematical activities because they are incorporating mathematics in various situations during the day. Thus, Nina stated: *"As a negative experience, I would point out that my mentor considers morning circle as a mathematical activity and for this reason, she does not carry out planned mathematical activities."* Eva's observations are similar: *"I noticed that in my group mathematics was often involved in spontaneous conversations and during spontaneous play, while planned mathematical activities hadn't been performed, not even once."* It seems that kindergarten teachers are not aware (enough) that the play does not suffice and that mathematics should be presented to the children in a planned way (Moss et al., 2016).

In connection with the research of Nudl et al. (2012), which reported on the frequency of mathematical activities in Slovenian kindergartens, quite a few parallels can be observed. Despite the fact that the present research was carried out 7 years later and focused only on planned activities, it showed almost identical findings regarding the representation of mathematical content areas. Similar to their research, this research indicated the predominance of arithmetic activities as well. Ginsburg et al. (2008) pointed out that limiting early mathematics to counting most likely steams from an underestimation of children's abilities. Furthermore, in accordance with Nudl et al. (2012), this research showed that the least frequently performed activities were in the field of algebra. However, in contrast, the present study revealed progress in the frequency of performed geometric activities. Namely, compared to the 14.0 % rate of geometric activities detected in the research conducted by Nudl et al. (2012), present findings suggest that as much as 27 % of all planned activities were associated with geometry. Considering that some previous studies revealed that geometry is typically the least known subject for early years teachers (such as Clements & Sarama, 2011; Lee, 2010), the findings of this study are quite encouraging.

There are certain limitations of this study that should be considered. First, the manifestation of planned mathematical activities was investigated by analyzing pre-service kindergarten teachers' reports. It would certainly be better if the observations could be carried out directly by the researcher, but in that case, it would be very difficult to cover as many different kindergartens across Slovenia as the current method allowed. Furthermore, in the academic year of 2016/17, the integrated practical training included only 4 full-day kindergarten visits (4 consecutive Fridays). Taking into consideration that some kindergartens may have had other activities previously planned for those days, that could contribute to the relatively low number of mathematical activities recorded. From this point of view, it might seem that it would be better to analyze students' reports from their concise 4-week internship. However, that data is unlikely to provide a deeper insight since during the concise internship, students are required to carry out several activities covering all curriculum content areas and therefore the learning process in kindergartens is at that time often adopted to accommodate students' internship agenda.

This study pointed out the crucial importance of finding ways how to encourage Slovenian kindergarten teachers to pay more attention to planned mathematical activities. First and foremost, there is a need to raise awareness that the development of intuitive mathematics skills is not enough (Ginsburg, 2009; Hachey, 2013). In addition to promoting awareness of the importance of planned activities, seminars and workshops for kindergarten teachers should remind them of the problematic narrowing of mathematics to numbers and operations (Lee & Ginsburg, 2007) and encourage them to include diverse activities covering other mathematical content areas as well. Furthermore, until recently, there were not many Slovene-language materials on early mathematics available for early childhood educators. The publication of literature that reaches kindergartens and early childhood educators (for example Lipovec & Antolin Drešar, 2019) might at least assist them with new ideas and approaches when planning mathematical activities.

References

Antolin Drešar, D (2017a). Integration of mathematics with other areas of curriculum in Slovenian kindergartens. In R. Kissné Zsámboki & C. Horváth (Eds.) *Diverzitás a hazai és nemzetközi neveléstudományi kutatásokban és a pedagógiai gyakorlatban*. Egyetem Kiadó.

Antolin Drešar, D. (2017b). Povezovanje gibanja in matematike v slovenskih vrtcih [Integration of movement and mathematics in Slovenian kindergartens]. In A. Bartos, S. Kerec & T. Horvat (Eds.), *Razvojni potenciali z vidika prehrane, gibanja in zdravja*, (pp. 19–27).

Bargagliotti, A. E., Guarino, C. M., & Mason, W. M. (2009). *Mathematics in kindergarten and first grade in the United States at the start of the 21st century.* On-line Working Paper Series, California Center for Population Research.

Bruce, C., Flynn, T., & Moss, J. (2016). *Early mathematics: Challenges, possibilities and new directions in the research.* Mathematics for Young Children: Literature Review, 2nd ed. http://tmerc.ca/pub/M4YC_LiteratureReview_25June12_RevisedSept2016.pdf

Copley, J. V. (2004). The early childhood collaborative: A professional development model to communicate and implement the standards. In D. H. Clements, J. Sarama & A. M. Dibiase (Eds.), *Engaging young children in mathematics: Findings of the 2000 national conference on standards for preschool and kindergarten mathematics education* (pp. 401–414).

Claessens, A., Duncan, G., & Engel, M. (2009). Kindergarten skills and fifth-grade achievement: Evidence from the ECLS-K. *Economics of Education Review, 28*(4), 415–427. https://doi.org/10.1016/j.econedurev.2008.09.003

Claessens, A., & Engel, M. (2013). How important is where you start? Early mathematical knowledge and later school success. *Teachers College Record*, *115*(6), 6–35.

Clements, D. H., & Sarama, J. (2007). Effects of a preschool mathematics curriculum: Summative research on the Building Blocks project. *Journal for Research in Mathematics Education*, *38*(2), 136–163.

Engel, M., Claessens, A., & Finch, M. (2013). Teaching students what they already know? The (mis)alignment between mathematics instructional content and student knowledge in kindergarten. *Educational Evaluation and Policy Analysis, 35*(2), 157–178.

Geary, D.C., Hoard, M. K., Nugent, L., & Bailey, H. D. (2013). Adolescents' functional numeracy is predicted by their school entry number system knowledge. *PLoS ONE, 8*(1), e54651. https://doi.org/10.1371/journal.pone.0054651

Ginsburg, H., Pappas, S., & Seo, K. (2001). Everyday mathematical knowledge: Asking children what is developmentally appropriate. In S. Golbeck (Ed.), *Psychological perspectives on early childhood education: Reframing dilemmas in research and practice* (pp. 181–219).

Ginsburg, H. P., Lee, J. S., & Boyd, J. S. (2008). Math education for young children: What it is and how to promote it. *Social Policy Report, 22*(1), 3–11. https://doi.org/10.1002/j.2379-3988.2008.tb00054.x

Ginsburg, H. P. (2009). The challenge of formative assessment in mathematics education: Children's minds, teachers' minds. *Human Development, 52*, 109–128. https://doi.org/10.1159/000202729

Greenfield, D., Jirout, J., Dominguez, X., Greenberg, A., Maier, M., & Fuccillo, J. (2009). Science in the preschool classroom: A programmatic research agenda to improve science readiness. *Early Education and Development, 20*(2), 238–264. https://doi.org/10.1080/10409280802595441

Hachey, A. C. (*2013). The early childhood mathematics education revolution. Early Education and Development*, *24*(4), 419–430.

Kurikulum za vrtce [Curriculum for kindergartens]. (1999). Ministry of Education and Sports.

Lee, J., & Ginsburg, H. P. (2007). What is appropriate mathematics education for four-year-olds? Pre-kindergarten teachers' beliefs. *Journal of Early Childhood Research, 5*(1), 2–31. https://doi.org/10.1177/1476718X07072149

Lee, J. (2010). Exploring kindergarten teachers' pedagogical content knowledge of mathematics. *International Journal of Early Childhood,* 42(1), 27-41.

Lipovec, A., & Antolin Drešar, D. (2019). *Matematika v predšolskem obdobju* [Math in the pre-school period]. Univerzitetna založba Univerze.

Marentič Požarnik, B. (2003). *Psihologija učenja in pouka* [Psychology of learning and teaching]. DZS.

Moss, J., Bruce, C., & Bobis, J. (2016). Young children's access to powerful mathematical ideas: A review of current challenges and new developments in the early years. In L. English & D. Kirshner (Eds.), *Handbook of international research in mathematics education* (3rd Ed., pp. 153–190). Taylor & Francis.

National Research Council. (2009). *Mathematics learning in early childhood: Paths toward excellence and equity.* The National Academies Press. https://doi.org/10.17226/12519

Nudl, A., Brezočnik, D., Lipovec, A., & Antolin Drešar, D. (2012). Struktura zastopanosti matematičnih dejavnosti v slovenskih vrtcih [The representative structure of mathematical activities in Slovenian kindergartens]. *Matematika v šoli, 18*(1/2), 5–14.

Phillips, D. A., Gormley, W. T., & Lowenstein, A. E. (2009). Inside the pre-kindergarten door: Classroom climate and instructional time allocation in Tulsa's pre-K programs. *Early Childhood Research Quarterly*, *24*(3), 213–228.

Reys, B. J., Chval, K. B., & Switzer, J. (2008). *Mathematics standards for kindergarten: Summary of state-level attention and focus.* Paper commissioned by the NRC Early Childhood Mathematics Committee.

Ritchie, S. J., & Bates, T. C. (2013). Enduring links from childhood mathematics and reading achievement to adult socioeconomic status. *Psychological Science*, *24*(7), 1301–1308. https://doi.org/10.1177/0956797612466268

Rudd, L. C., Lambert, M., Satterwhite, M., & Zaier, A., (2008). Mathematical language in early childhood settings: What really counts? *Early Childhood Education Journal*, *36*(1), 75–80. https://doi.org/10.1007/s10643-008-0246-3

Sarama, J. (2002). Listening to teachers: Planning for professional development. *Teaching Children Mathematics, 9*, 36–39.

Tepylo, D. H., Moss, J., & Stevenson, C. (2015). A developmental look at a rigorous block play program, *Young Children, 70*(1), 18–25.

TESTING MOTOR PREDISPOSITIONS AND COMPETENCES OF PRIMARY SCHOOL CHILDREN IN THE CZECH AND SLOVAK REPUBLICS

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Abstract The aim of this study was to monitor the level of basic movement competences of children at the onset of school attendance, and to compare the results of fitness tests with the ones of genetic analysis for the purpose of sport talent identification. The research sample included 449 pupils attending elementary schools in the regions of Nitra, Slovakia, and Prague, Czech Republic. During the first phase, 271 pupils (152 males, mean age = 7.438; 119 females; mean age = 7.227) underwent 9 fitness tests to determine general physical abilities. Subsequently, 30 best scoring pupils were selected for genetic tests. The results in fitness tests do not match the ones obtained from the genetic analysis. During the second phase of the project, 178 pupils (93 males, 85 females) aged 7.31 years (SD±0.93 years) participated, out of whom 109 were Slovak and 69 Czech pupils. The level of performance of the Czech sample in object control tests is significantly higher than the one of the Slovak sample. Gender differences in object control tests were found in favor of boys.

Keywords: basic movement competences, fitness tests, gender differences, genetic analysis, 7-year-old pupils, sports talent identification.

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Introduction

Fundamental movement skills at an early age of children

Gross motor development is an area often overlooked by early childhood educators, including those in special education. During the pre-school and elementary years, a child's motor ability begins to mature. Physical growth and a child's history of movement experiences play a fundamental role in influencing shifts in movement patterns. If deficits in gross motor development are not identified and remediated, the child may experience lifelong problems with motor skills (Scheuer et al., 2017). Typical development is marked by well-observed patterns of motor behaviors, including reflexes, voluntary movements, and goal-directed actions. As a child progresses from infancy through early childhood, parents, teachers and clinicians serve the important role of identifying children with motor deficiencies. Parents and teachers can identify a child with a potential motor impairment. They may also aid clinicians and researchers in assessing and monitoring motor competence as part of a research study or investigation progress (Bardid et al., 2018). Therefore, the evaluation of gross motor development should represent an important aspect of early childhood screening programs.

Early childhood is a critical period for the development of fundamental movement skills (Hardy et al., 2010). The acquisition of fundamental movement skills is developmentally sequenced (Branta et al., 1984) and is contingent upon multiple internal and external factors (biological, psychological, social, motivational, cognitive, etc.) and the process of acquisition occurring through a range of active play experiences and structured programs. These skills allow children to interact with and explore their environment (Gallahue & Ozhun, 2002). Children who do not master fundamental movement skills are more likely to experience failure in the motor domain and less likely to participate in sport and games during childhood and adolescence. Studies among primary-school aged children report low levels of fundamental movement skills mastery indicating the need to implement fundamental movement skills programs during the preschool years (Hardy et al., 2010).

Furthermore, research among school aged children (Barnett et al., 2008; Barnett et al., 2008; Patterson, 2001) shows that mastery of fundamental movement skills is correlated with higher levels of physical activity, and there is emerging evidence among preschoolers that fundamental movement skills (Fisher, 2005), and in particular locomotor skills are also positively associated with physical activity. Studies among primary-school aged children indicate low levels of fundamental movement skills mastery (Okely, 2004; van Beurden et al., 2002). Therefore, it appears prudent to examine fundamental movement skills already in preschool and early-school aged children.

Testing motor competences

Testing motor predispositions and competences in physical education has gained in relevance over the last decades. In primary schools the aim of testing is to identify students with motor deficiencies and/or to assess motor proficiency levels in general.

The term *motor competence* relates to the development and performance of human movement (Stodden et al., 2008). Motor competence has encompassed a wide variety of terms such as fundamental motor skill or movement, motor proficiency or performance, motor ability and motor coordination (Robinson et al., 2015). Motor competence can also be explained as a person's ability to carry out different motor acts, including coordination of both fine (for example, manual dexterity) and gross (for example, static and dynamic balance) motor skills (Henderson & Sugden, 1992).

Numerous current research studies reported positive associations between motor competence and physical activity (Holfelder & Schott, 2014; Lubans et al., 2010), and motor competence and health related fitness (Haga, 2008; Stodden et al., 2014). The results of the recently published study by Luz et al. (2017) showed that motor competence has an influential role in the development of health-related fitness during childhood. Working with children to develop motor competence from an early age will trigger the achievement of better health related fitness, probably through the involvement of children in physical activities, sports and free play activities. Since childhood is a critical period for the acquisition of motor competence and health related fitness, it should be fundamental to promote both motor competence and health related fitness to benefit a healthy development of children.

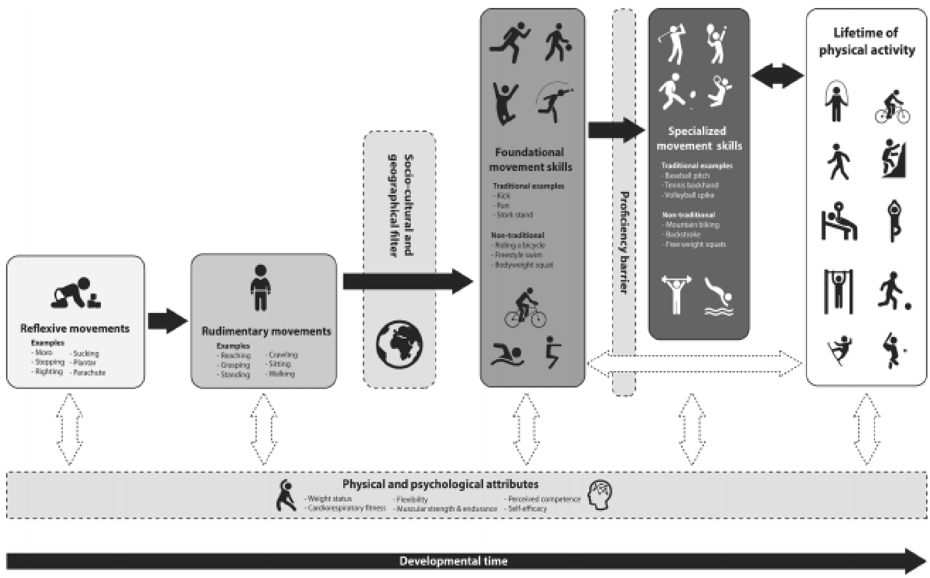
Basic motor competences (BMC) are motor performance predispositions expressed as minimum standards empowering children to participate in the movement culture. Or, they can alternatively be defined as a prerequisite for active participation in the culture of movement, play, and sports (Scheuer et al., 2017). They ensure that children and adolescents can participate in the education-related processes of this culture (Gogoll, 2012; Herrmann et al., 2015). BMC express a level of minimal requirements in the form of minimum standards. They determine the lower limit of the ability to move. One should not confuse BMC with motor abilities and sport motor skills. Unlike motor abilities, motor qualifications are always complex and context-bound. Furthermore, they are also more general than specific skills and form a foundation upon which skills and thus further development of competence are built (Scheuer et al., 2017).

The promotion of basic motor competences is a main goal of physical education lessons, since they are essential prerequisites to be able to develop a physically active lifestyle (Hulteen et al., 2018). There exist several different test batteries to assess basic motor competences of children and adolescents, however, there is not yet a consensus on which constructs comprise motor competence. The choice of test battery depends on different factors, such as the suitability of the test for the age group, the purpose of the measurement and the facilities/environment where the assessment takes place (Bardid et al., 2018). The most recently used batteries include: MOBAK and TGMD batteries. The former identifies three different areas of motor competence: locomotion, object-control, and moving in water, while the latter includes only two areas: locomotion, and object-control. The test of gross motor development – second edition (TGMD-2) was developed to meet the need for a well-constructed, standardized test. Gross motor development frequently includes movement behaviors that are used to transport the body from one location to another and to project and receive objects, especially balls. Hence, locomotion and object control behaviors form the nucleus of the general domain are measured by TGMD-2. In particular, the TGMD-2 measures how children coordinate their trunk and limbs during a movement task performance rather than assessing the end result (such as how fast they ran, how far they threw the ball). Clark (1994) described multiple, sequential periods, during which qualitative differences are observed in a child's motor behavior (Table 1). He added that individuals move through various periods at different rates, based on the confluence of multiple internal (biological, psychological, motivational, cognitive, social, and so forth) and external factors (the environment).

Table 1 Sequential periods reflecting qualitative differences in motor behaviors (Clark, 1994)

Time interval	Stage	Major periods
Neonatal (first 2–3 months)	1	Reflexive and spontaneous movements
First 12–14 months	2	Preadapted behavior repertoire
Preschool and early elementary years	3	Fundamental gross motor behaviors
Middle elementary through adulthood	4	Sport- and context-specific movements

In the last decade, an increase in sedentary behavior during occupational and domestic activities and insufficient participation in physical activity during leisure time have been reported in many research articles (Epstein, 2001; Troiano, 2008). Developing motor skill competence may be fundamental in developing and maintaining adequate physical fitness into adulthood (Stodden et al., 2009). Children with high motor skill proficiency will have higher levels of fitness and perceived sports competence, which in turn predict greater participation in physical activity, and vice versa (Lubans et al., 2010). Evidence suggests that motor skill acquisition in early childhood may be an essential prerequisite for child physical activity participation and engagement in physical activity later in life (Hulteen et al., 2018; Loprinzi et al., 2015; Luz et al., 2017; Stodden et al., 2009). Failure to develop competency in fundamental movement skills will make learning more advanced/specialized forms of these skills more difficult. The importance of the fundamental movement skills phase is denoted as a time crucial for creating a broad base of skill competences thus promoting the greatest potential for skill transfer to other complexed skills. Along with learning more advanced skills, the levels of competency needed are higher due to the demands of specific activities (Langendorfer et al., 2011). In this context, discussion is on the way concerning which skills should be taught to children and adolescents in different developmental periods. A partial answer to this topical question is given by Hulteen et al. (2018) who proposed a conceptual model of the development of movement skills from reflexive movements to specialized movement skills (Figure 1). In this model, reflexive and rudimentary goal-oriented movements provide the basis for further development of more complex movement skills. Later on, fundamental movement skills emerge. However, they do not include the full range of skills that may allow children to participate in physical activities and sports throughout their lifespan. In context of this, Hulteen et al. (2018) suggested a new term 'foundational movement skills' which better reflects the wide variety of skills in which an individual should develop competency. Foundational movement skills are thus defined as goal-directed movement patterns that directly and indirectly impact an individual's capability to be physically active and can be developed to enhance physical activity participation and promote health throughout life.



Explanations: Black arrows indicate previously hypothesized pathways; white arrows and dotted boxes indicate newly hypothesized pathways/components unique to this conceptual model

Figure 1 Model of the development of foundational movement skills for physical activity across the lifespan
(Hulteen et al., 2018)

Sport talent identification through detecting motor competences

Detecting motor competences in children can also facilitate identification of sport talented individuals already in the first years of their school attendance. The talent identification process usually involves a physical (anthropometry) and physiological (performance measures: speed, strength, aerobic and anaerobic power) testing battery relevant to the demands of the sport. However, a one-dimensional approach in talent identification based on physical and physiological parameters can be misleading. Rather, a multidisciplinary approach addressing physical, physiological, technical, sociological and psychological predictors should be conducted (Meylan et al, 2010).

Sport talent identification through genetic testing

Fitness tests formerly used for talent identification at an early age cannot properly find the future talent because the tests results depend on the specific point in time of testing with respect to the athlete's optimal training level, daily physical state and health (Burgess & Naughton, 2010). If an athlete is not able to show his or her best performance in the test situation, the results do not reflect his or her "real abilities". Therefore, an alternative approach of talent development instead of the conventional "snap-shot" testing has been proposed. Genetic testing has become a new method of disclosing the background of sports talents (Bouchard et al., 2011). At present, research projects are aimed at integrated measurements of the effect of various genes and environmental effects on one's genotype. Genetic tests differ in principle from the traditional motor tests, because DNA of an individual does not change during their early childhood. Genetics play an important role in determining the capacity of an individual to go in for sports at the top professional level. The question is which genetic elements influence motor abilities and what is their respective significance. Furthermore, it is necessary to know the related genes as well as the mechanisms and metabolic paths and their influence. Sports performance is not determined only by a single gene but concurrent interactions of several genes (Sessa et al., 2011). Genetic tests can inform trainers and athletes on the type of physical activity (endurance or speed) suitable for the given individual. The results of fitness tests can provide them only with partial information on the momentary state of fitness of children. However, such information can be fruitful for them when developing individual training programs and in discovering talented children. The sole use of genetic analysis can offer only hereditary characteristic of an individual, which, however, need not be developed during the life of the person.

The aim of the article was to monitor the level of basic motor competences of children at the onset of their school attendance. Attention was also paid to the comparison of the results of fitness tests with the ones of genetic analysis for the purpose of sport talent identification.

Method

The research procedure consisted of three different protocols: Fitness Testing (1), Gross Motor Development Testing (2), and Genetic Analysis (3).

First phase – fitness testing

The research sample included 271 children (152 males and 119 females) aged 6–8 years (mean age = 7.36 years) attending the first grade at 3 elementary schools in Nitra, Slovakia. Basic characteristics of the sample are presented in table 2.

Table 2: Basic characteristics of the sample

Slovak sample (SK) (*n* = 271)	Decimal age	Body Height	Body Mass	Body mass index
Boys (*n* = 152)	7.39	126.91	26.75	16.52
Girls (*n* = 119)	7.34	125.34	25.24	15.98

Fitness testing for sport talent identification included 8 items: Coordination test with a stick, Arm hang, Standing Broad Jump, 4x10m Shuttle Run, 30s Sit-ups, Sit-and Reach test, Rolling of 3 Balls, 20m Beep Test. Somatic measurements included body height, body mass, and BMI (Šimonek, 2018). The test results were assessed using the 7-point scale according to the procedure by Moravec et al. (2002). The total score of individual children was formed by adding the points from individual fitness tests. The 30 best children who scored highest points (out of the total 271 children) were recommended for genetic testing.

Second phase – gross motor development testing

The research sample consisted of 178 children (93 male; 85 female) aged 7.31 years (*SD*±0.93 years), out of whom 109 were Slovak and 69 Czech pupils. Characteristics of the samples are presented in tables 3 and 4. In the second phase of the project, locomotion and fundamental skills of children were tested.

Table 3: Characteristics of the sample of Czech pupils (n = 69)

Czech sample (CZ) (*n* = 69)	Decimal age	Body Height	Body Mass	Body mass index
Boys (*n* = 34)	7.39	128.6	27.6	16.6
Girls (*n* = 35)	7.33	126.2	25.2	15.7

Table 4: Characteristics of the sample of Slovak pupils (n = 109)

Slovak sample (SK) (*n* = 109)	Decimal age	Body Height	Body Mass	Body mass index
Boys (*n* = 59)	7.27	126.1	27.3	16.8
Girls (*n* = 50)	7.24	123.3	25.5	15.9

Gross Motor Development Testing included two subtests (Locomotor and Object Control) that make up the TGMD-2 (Scheuer et al., 2017). By means of these two subtests the level of gross motor development of selected children was assessed. The Locomotor subtest measures the following gross motor skills that require fluid coordinated movements of the body as the child moves in one direction or another: Run, Gallop, Hop, Leap, Horizontal Jump, and Slide. The Object Control subtest measures the following gross motor skills that demonstrate efficient throwing, striking, and catching movements: Striking a Stationary Ball, Stationary Dribble, Catch, Kick, Overhead Throw, and Underhand Roll. Each gross motor skill included several behavioral components that were presented as performance criteria. In general, these behaviors represented a mature pattern of the skill. If the child performed a behavioral component correctly, the examiner marked a 1; if the child did not perform a behavioral component correctly, the examiner marked a 0. After completing this procedure for each of the two trials, the examiner totaled the scores of the two trials to obtain a raw skill score for each item (run, gallop, hop, etc.). The entire TGMD-2 lasted for approximately 15-20 minutes for one child.

Statistical procedure included arithmetic mean, standard deviation (Tables 5 and 6), and Man-Whitney U-test for independent samples (Tables 7 through 9). Cohen's *d* was used to indicate the standardized difference between two means.

Third phase – genetic analysis

The research sample consisted of 30 pupils with the highest number of points scored in fitness tests. The third protocol represented genetic analysis of samples of 2ml saliva (GeneFix Saliva Collectors). The samples were analyzed using the apparatus HiScan (Illumina Inc., San Diego, USA), which allowed for analyzing 400.000 polymorphisms in a human gene. The values of individual genetic scores were compared with a histogram of genetic score distribution in European population. Software Genomestudio (Illumina Inc., San Diego, USA) and software TANAGRA 1.4.50 were used for data analysis (Šimonek & Židek, 2019).

Instruments and analysis: Four separate panels of genetic markers were selected for analysis. An unweighted "genetic score" based on contribution to anaerobic capacity, sport motivation, muscle pain and body mass had been calculated. A score of "0" represented the homozygote for the low-response variant; "1" represented heterozygous and "2" represented homozygous for the high-response allele. In certain variants with significantly higher impact was the genetic score increase to "2" for heterozygous and "4" for homozygous high-response allele. Sum of genetic score calculated for each haplotype has been enriched by probability to observe a specific haplotype in the European (Caucasian) population. The overall population risk has been visualized as a histogram of given genetic score based on frequencies of all possible haplotypes in the European population. The calculated rate of the genetic score had been confronted with the histogram of genetic score distribution of 30 control individuals genotyped through Illumina chip HumanOmniExpress-24 (23andMe v3, v4, v5) and derived from the project NU3Gen.

Results

The results of measurements of both locomotion and object control skills in the Slovak sample are presented in Tables 5 and 6.

Table 5: Statistical data for the Slovak sample

LOCOMOTIONS							
Group/test	run	gallop	hop	leap	board jump	slide	TORAL
BOYS	6.73 ± 1.9	6.19 ± 2.31	8.42 ± 2.51	5.20 ± 1.27	6.63 ± 1.73	6.61 ± 1.82	39.78 ± 7.1
GIRLS	6.82 ± 1.52	6.24 ± 2.40	9.02 ± 1.56	5.14 ± 1.43	6.34 ± 2.02	6.54 ± 1.81	40.10 ± 6.33
OBJECT CONTROL							
Group/test	strike	dribble	catch	kick	throw	roll	TORAL
BOYS	3.22 ± 1.46	3.56 ± 2.51	3.68 ± 1.73	4.80 ± 1.71	3.05 ± 1.91	3.68 ± 1.86	21.98 ± 6.02
GIRLS	2.96 ± 1.06	2.14 ± 2.56	3.44 ± 1.70	3.58 ± 1.56	2.60 ± 1.43	3.00 ± 1.37	17.72 ± 5.21

Table 6: Statistical data for the Czech sample

LOCOMOTIONS							
Group/test	run	gallop	hop	leap	board jump	slide	TORAL
BOYS	7.12 ± 1.45	6.18 ± 1.76	8.18 ± 2.05	5.26 ± 1.13	6.77 ± 1.15	6.53 ± 1.38	40.03 ± 5.01
GIRLS	7.13 ± 1.20	6.08 ± 1.74	8.14 ± 1.99	4.94 ± 1.22	6.86 ± 0.95	6.57 ± 1.38	39.71 ± 4.99
OBJECT CONTROL							
Group/test	strike	dribble	catch	kick	throw	roll	TORAL
BOYS	6.27 ± 1.38	5.15 ± 2.13	4.38 ± 1.15	6.59 ± 1.59	5.71 ± 1.58	4.82 ± 1.48	32.91 ± 6.02
GIRLS	5.31 ± 1.70	4.14 ± 2.16	3.86 ± 1.27	4.09 ± 1.99	4.57 ± 1.64	4.03 ± 1.62	26.00 ± 4.78

When looking at gender differences within the Slovak sample, we can state that they showed higher values in girls in the leap, broad jump and slide tests, while boys scored higher values in the rest of locomotion tests and all object control tests (Table 7). When evaluating gender differences in elementary locomotion tests**,** no statistical significance ($p > .05$) was detected in any of the six tests. On the contrary, when looking at gender differences in overall test results of motor skills, statistically significant difference was observed ($p < .01 = .001$; $d = .719$). In particular tests, the following results were found: No statistical significance was found in the tests of Striking the ball ($p > .05 = .528$; $d = .199$), Ball catching ($p > .05 = .547$; $d = .109$), Ball throwing ($p > .05 = .206$; $d = .266$), and Ball rolling ($p > .05 =.107$; $d = .392$), while positive significance was proved in the tests of Dribbling ($p < .01 = .003$; $d = .538$), and Ball kicking ($p < .01 =.001$; $d = .703$). All significant differences were in favor of boys.

Table :7 Gender differences in locomotion and skills tests within the Slovak sample

Locomotion	P	Cohen's d		Skills	p	Cohen's d
run	.662	-0.02773		**strike**	.528	0.199
galop	.951	0.02482		**dribble**	.003**	0.538
hop	.619	-0.24392		**catch**	.547	0.109
leap	.979	0.08970		**kick**	< .001**	0.703
broad jump	.383	0.18249		**throw**	.206	0.266
slide	.788	0.00561		**roll**	.107	0.392
Total	.844	-0.00602		**Total**	< .001**	0.719

Legend: ** gender differences ($p \leq .01$). Effect size significance: 0.2 – 0.49 = small effect; 0.5 – 0.79 = medium effect; 0.8 < large effect.

Gender differences within the Czech sample showed higher values in girls in the run, broad jump and slide tests, while boys scored higher values in the rest of locomotion tests and all object control tests (Table 8). There was a very slight difference in total values of locomotion tests. When looking at gender differences in elementary locomotion tests**,** no statistical significance ($p > .05$) was detected in any of the six tests. On the contrary, when evaluating gender differences in overall test results of motor skills, statistically significant difference was observed ($p < .01 = .001$; $d = 1.239$).

Table 8 Gender differences in locomotion and skills tests within the Czech sample

Locomotion	P	Cohen's d		Skills	p	Cohen's d
run	.771	0.00246		**strike**	.020*	0.596
galop	.772	0.05035		**drible**	.095	0.455
hop	.896	0.01618		**catch**	.140	0.421
leap	.231	0.26544		**kick**	< .001**	1.348
broad jump	.940	-0.08545		**throw**	.007**	0.685
slide	.891	-0.02960		**roll**	.062	0.496
Total	.791	0.06127		**Total**	< .001**	1.239

Legend: * gender differences ($p \leq .05$), ** gender differences ($p \leq .01$); Effect size significance: 0.2 – 0.49 = small effect; 0.5 – 0.79 = medium effect; 0.8 < large effect.

In particular tests the following results were found: No statistical significance was found in the tests of Dribbling ($p > .05 = .095$; $d = .455$), Ball catching ($p > .05 = .140$; $d = .421$), and Ball rolling ($p > .05 = .062$; $d = .496$), while positive significance was proved in the tests of Striking the ball ($p < .05 = .020$; $d = .596$), Ball kicking ($p < .01 =.001$; $d = 1.348$), and Ball throwing ($p < .01 = .007$; $d = .685$), All significant differences were in favor of boys.

To compare the level of basic locomotion and fundamental object control skills between the Slovak and Czech samples comparative analysis was employed. Based on the small sample size a non-parametric Mann-Whitney U-test was used for finding the differences between the two samples. Logical relations were evaluated using the Cohen's *d* test. The results are depicted in Table 9.

No statistical differences, with the exception of the Hop test (p < .05 = .027; $d = .166$), were found in the level of the components of locomotion tests between the Slovak and Czech samples (Table 9). However, statistically significant differences in favor of the Czech sample were observed in object control tests as a whole ($p < .01$; .001; $d = 1.86$), at 5 % level of statistical significance in Ball catching ($p < .05 = .030$; $d = .349$), and at 1 % level of statistical significance in Striking the ball ($p < .01 = .001$; $d = 1.850$), Ball dribbling ($p < .01 = .001$; $d = .693$), Ball kicking ($p < .01$; .001; $d = .553$), Ball throwing ($p < .01 = .001$; $d = 1.320$), and Ball rolling ($p < .01 = .001$; $d = .629$).

Table 9: Differences between the Czech and Slovak samples in locomotion and object control tests

Locomotion	p	Cohen's d	Skills	p	Cohen's d
run	.131	-0.2677	**strike**	< .001**	-1.850
gallop	.292	-0.0140	**drible**	< .001**	-0.693
hop	.027*	0.1660	**catch**	.030*	-0.349
leap	.549	-0.0145	**kick**	< .001**	-0.553
broad jump	.931	-0.2481	**throw**	< .001**	-1.320
slide	.481	-0.0505	**roll**	< .001**	-0.629
Total	.357	-0.0243	**Total**	< .001**	1.86

Legend: * gender differences ($p \leq .05$); ** gender differences ($p \leq .01$); Effect size significance: 0.2 – 0.49 = small effect; 0.5 – 0.79 = medium effect; 0.8 < large effect.

The results obtained during the second phase of our research showed that, by implementing the obligatory testing of motor prerequisites of children in Slovakia, we obtained a significant sample which can help identifying and selecting young talents in sports. Based on the broad data basis, parents and coaches will have the better chance to identify a potential sport talent and select them for the particular sport activity both in the sport club or in recreational activity. Selecting the top 10 % of children according to the results of motor tests did not reflect the results of genetic testing since in all 7 different parameters of sport performance the results did not match the ones obtained through motor testing. Some children showed a good level of performance in strength tests but scored low in endurance and coordination tests. It was also found that despite the high level of performance of some children in physical tests, they, on the contrary, showed a high risk of muscle injury and a low level of trainability. These are obstacles to improving sports performance in these individuals. However, based on the analysis of genes and motor prerequisites we offered parents and coaches valid information about their children's prerequisites to a certain group of sports, particularly oxidative capacity, regeneration speed, injury prevention, anaerobic capacity, motivation for sports, muscle pain susceptibility, and type of energetic metabolism.

Discussion and Conclusion

The preschool environment plays an important role in fostering and developing children's fundamental movement skills. The current findings highlight the need for teachers to provide structured opportunities which facilitate children's development and confidence in performing basic skills, which may include providing gender separated games, equipment and spaces. Playing games that are fun, inclusive and skill-based will help prepare children to participate in a wide variety of physical activities with greater success and enjoyment. Investments in fundamental skills development programs during early childhood are important because they have the potential to enable children to participate successfully in games and sports during adolescence and adulthood, and once learned, the skills are retained for life.

The overall results of our research suggested that while the level of performance of both samples in basic locomotion is not significantly different, the level of performance of the Czech sample in object control tests is significantly higher than the one of the Slovak sample ($p < .01 = .001$; $d = 1.86$). We hypothesize that one of the reasons for better performance of the Czech children in object control tests was the fact that elementary school teachers in the Czech sample devoted more time in the curriculum to object control skills exercises. Administrators from the Czech partner proved this presumption true. More than one half of the content of physical education lessons in Czech primary school classes is formed by coordination exercises, dribbling, passing, catching throwing, rolling, hitting, striking, and similar. Significant gender differences in favor of boys in object control tests in both countries could be attributed to more frequent involvement of boys in ball games during their free time. Similar results were obtained by Ré et al. (2017).

Another explanation can be found in physical and motor development of both genders. Boys and girls develop differently in a few ways, and researchers are always studying the genes, hormones, and brain chemistry that might explain some of these differences. Of course, an individual child's development may not fit neatly within gender lines. Between the big growth stages of infancy and adolescence, boys and girls grow in height and weight at about the same slow, but steady rate. There aren't notable differences between the sexes until late elementary school – that's when girls start to grow taller faster, although boys catch up and surpass them within a few years. Boys' gross motor skills (running, jumping, balancing) tend to develop slightly faster, while girls' fine motor skills (holding a pencil, writing) improve first (Ding, 2020). Researchers continue to study the developmental differences between boys and girls and what causes them, but it's important to remember that biology alone doesn't determine the kind of son or daughter people will have. Exposing the child to a wide range of activities and experiences is the best way to support a well-rounded, active child.

Based on the results of our measurements we can assume that the content of physical education lessons at the primary level of education can contribute to the acquisition of motor competence and health related fitness to a great degree. This period of life is the crucial one for the promoting of both motor competence and health related fitness to benefit a healthy development of children. Professionals responsible for delivering gross motor programs should have a valid and reliable assessment tool, such as TGMD-2, to document the effectiveness of their programs. Teachers should establish realistic expectations for the amount of progress children should make from the beginning to the end of the school year. Based on tests of basic locomotor and manipulative skills, P.E. teachers can suggest sport coaches talented individuals for the regular sport training. However, the main issue is determining which test battery should be used to detect the key competences of young talents. When we have a look at the up-to-date sources (such as Clark, Meylan et al, and others), we can state that since motor capabilities have their sensitive periods only later during adolescence, it is thus necessary to follow and observe the process of learning motor skills of children during their early life. The tempo of motor learning should be one of the main factors indicating the sport talent in an individual. When we consider this assumption to be valid, test batteries comprising locomotor and manipulative skills tests (such as MOBAK and TGMD) should be preferred. However, test results cannot determine the real talent development. Only long-lasting hard training work can bring the success in top sport.

In the future research, it is inevitable to pay attention to the potential tempo of development of abilities and skills. A comparison of pretest and posttest results will indicate whether the pupils made significant progress or not.

The research attempted also at comparing different methods of sport talent identification. Results of the genetic analysis and measurement of motor abilities of selected children aged 7–8 years suggest that genetic testing of young athletes offers a suitable method of identifying performance prerequisites just before their development. Genetic tests can inform trainers and athletes on the type of physical activity (endurance or speed) suitable for the given individual. The results of fitness tests can provide them only with partial information on the momentary state of fitness of children. We can recommend both ways of identifying sport talents. We assume that genetic testing of young athletes offers a suitable method of identifying performance prerequisites just before their development. However, such information can be fruitful for them when developing individual training programs and in discovering talented children. The sole use of genetic analysis can offer only hereditary characteristic of an individual, which, however, need not be developed during the life of the person. Genetic analysis may be considered to be a suitable and practical alternative for fitness-oriented testing of the population.

A limitation to this study is the use of only one single test battery of gross motor coordination as the measurement of motor competence. Furthermore, the application of tests only on a sample consisting of children aged 6–7 limits our conclusions on a certain age group. Therefore, future research should investigate cross-cultural differences (not only in two Central European countries) in fundamental movement skills of a larger age span in order to understand the issues of motor competence in a broader sense.

This study provides valuable information on comparison of motor competence levels in children of two countries using the TGMD-2 test battery. Present results show that there are only slight differences in basic locomotor movements between genders. However, significant differences in favor of boys were found in object control tests proving that boys show a higher level of manipulative skills, especially kicking and dribbling the ball. These results can be explained by the fact that boys play with balls in their free time. Girls prefer basic locomotion movements, sometimes accompanied by music.

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References

Bardid, F., Vannozzi, G., Logan, S. W., Hardy, L. L., & Barnett, L. M., (2018). A hitchhiker's guide to assessing young people's motor competence: Deciding what method to use. *Journal of Science and Medicine in Sport, 22*(3), 311–318.

Barnett, L. M., van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2008). Does childhood motor skill proficiency predict adolescent fitness? *Medicine and Science in Sports and Exercise, 40*(12), 2137–2144.

Barnett, L. M., Morgan, P. J., van Beurden, E., & Beard, J. R. (2008). Perceived sports competence mediates the relationship between childhood motor skill proficiency and adolescent physical activity and fitness: A longitudinal assessment. *International Journal of Behavioral Nutrition and Physical Activity, 5*, Article 40. https://www.doi.org/10.1186/1479-5868-5-40

Barnett, L. M., van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2009). Childhood motor skill proficiency as a predictor of adolescent physical activity. The *Journal of Adolescent Health, 44*(3), 252–259.

Bouchard, C., Sarzynski, M. A., Rice, T. K., Kraus, W. E., Church, T. S., Sung, Y. J., et al. (2011). Genomic predictors of the maximal O_2 uptake response to standardized exercise training programs. *Journal of Applied Physiology, 110*(5), 1160–1170.

Branta, C., Haubenstricker, J., & Seefeldt, V. (1984). Age changes in motor skills during childhood and adolescence. *Exercise & Sport Sciences Reviews,12*, 467–520.

Burgess, D. J., Naughton, G. A. (2010). Talent development in adolescent team sports: A review. *International Journal of Sports Physiology and Performance, 5*(1), 103–116.

Clark, J. E. (1994). Motor development. In V. S. Ramachandran (Ed.), *Encyclopedia of human behavior* (Vol. 3; pp. 245–255). New York: Academic Press.

Ding, K. (2019, March 26). *Raising boys and girls: Differences in development.* BabyCenter. Retrieved on February 10, 2020, from: https://www.babycenter.com/0_raising-boys-and-girls-differences-in-development_3659011.bc

Epstein, L. H., Roemmich, J. N. (2001). Reducing sedentary behavior: Role in modifying physical activity. *Exercise and Sports Science Reviews, 29*(3), 103–108.

Fisher, A., Reilly, J. J., Kelly, L. A., Montgomery, C., Williamson, A., Paton, J. Y., et al. (2005). Fundamental movement skills and habitual physical activity in young children. *Medicine and Science in Sports and Exercise, 37*(4), 684–688.

Gallahue, D., & Ozmun, J. (2002). *Understanding motor development. Infants, children, adolescents, adults*. (5th ed.). New York, NY: McGraw-Hill.

Gogoll, A. (2012). Sport- und bewegungskulturelle Kompetenz – ein Modellentwurf für das Fach Sport [Sports and movement cultural competence – a model design for the subject physical education]. In A. C. Roth, E. Balz, J. Frohn & P. Neumann (Eds.), *Kompetenzorientiert Sport unterrichten* [Teaching competence-oriented sports] (pp. 39–52). Herzogenrath: Shaker.

Haga, M. (2008). The relationship between physical fitness and motor competence in children. *Child: Care, Health and Development, 34*(3), 329–334.

Hardy, L. L., King, L., Farrell, L., Macniven, R., & Howlett, S. (2010). Fundamental movement skills among Australian preschool children. *Journal of Science and Medicine in Sport, 13*(5), 503–508.

Henderson, S. E., Sugden, D. A. (1992). *The movement assessment battery for children*. The Psychological Corporation: Kent, UK.

Herrmann, C., Bund, A., Gerlach, E., Kurz, D., Lindemann, U., Rethorst, S., Scheuer, C., Seiler, S., & Pühse, U. (2015). A review of the assessment of basic motor qualifications and competencies in school. *International Journal of Physical Education, 52*(3), 2–13.

Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: a systematic review. *Psychology of Sport and Exercise, 15*(4), 382–391. https://doi.org/10.1016/j.psychsport.2014.03.005

Hulteen, R. M., Barnett, L. M., Morgan, P. J., Stodden, D. F., & Lubans, D. R. (2018). Development of foundational movement skills: A conceptual model for physical activity across the lifespan. *Sports Medicine, 48*(7), 1533–1540.

Langerdorfer, S. J., Roberton, M. A., & Stodden, D. F. (2011). Chapter 9: Biomechanical aspects of the development of object projection skills. In D. S. C. Korff (Ed.) *Paediatric biomechanics and motor control: Theory and application.* Oxford, UK: Routledge.

Loprinzi, P. D., Davis, R. E., & Fu, Y.-C. (2015). Early motor skill competence as a mediator of child and adult physical activity. *Preventive Medicine Reports, 2*, 833–838.

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports Medicine, 40*(12), 1019–1035. https://doi.org/10.2165/11536850-000000000-00000

Luz, C., Meester, A. D. Rodriguez, L. P., & Cordovil, R. (2017). The relationship between motor competence and health-related fitness in children and adolescents. *PloS ONE, 12*(6), e0179993. https://doi.org/10.1371/journal.pone.0179993

Meylan, C., Cronin, J., Oliver, J., & Hughes, M. (2010). Talent identification in soccer: The role of maturity status on physical, physiological and technical characteristics. *International Journal of Sports Science & Coaching, 5*(4), 571–592.

Moravec, R., Kampmiller, T., & Sedláček, J. (2002). *Eurofit – Telesný rozvoj a pohybová výkonnosť školskej populácie na Slovensku* [Eurofit – Physical development and movement performance of the school population in Slovakia]. (2nd ed.). Bratislava: Slovak Scientific Society for Physical Education and Sports.

Okely, A. D., & Booth, M. L. (2004). Mastery of fundamental movement skills among children in New South Wales: Prevalence and sociodemographic distribution. *Journal of science and medicine in sport, 7*(3), 358–372. https://doi.org/10.1016/S1440-2440(04)80031-8

Patterson, J.W. (2001). Relationship of physical activity to fundamental movement skills among adolescents. *Medicine and Science in Sports and Exercise, 33*(11), 1899–1904.

Ré, A. H. N., Logan, S. W., Cattuzzo, M. T., Henrique, R. S., Tudela, M. C., & Stodden, D. F. (2017). Comparison of motor competence levels on two assessments across childhood. *Journal of Sports Sciences, 36*(1), 1–6.

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine, 45*(9), 1273–1284.

Scheuer, C., Bund, A., Becker, W., & Herrmann, C. (2017). Development and validation of a survey instrument for detecting basic motor competences in elementary school children. *Cogent Education, 4*(1), Article 1337544. https://doi.org/10.1080/2331186X.2017.1337544

Sessa, F., Chetta, M., Petito, A., Franzetti, M., Bafunno, V., Pisanelli, D., & Margaglione, M. (2011). Gene polymorphisms and sport attitude in Italian athletes. *Genetic Testing and Molecular Biomarkers, 15*(4), 285–290. https://doi.org/10.1089/gtmb.2010.0179

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest, 60*(2), 290–306. https://doi.org/10.1080/00336297.2008.10483582

Stodden, D. F., Langendorfer, S., & Roberton, M. A. (2009). The association between motor skill competence and physical fitness in young adults. *Research Quarterly for Exercise and Sport, 80*(2), 223–229.

Stodden, D. F., Gao, Z., Goodway, J. D., & Langendorfer, S. J. (2014). Relationships between motor skill competence and health-related fitness in youth. *Pediatric Exercise Science*, *26*(3), 231–241. https://doi.org/10.1123/pes.2013-0027

Šimonek, J. (2018). Povinné testovanie pohybovej výkonnosti žiakov 1. ročníka ZŠ podľa nového zákona o športe. [Mandatory testing of physical performance of first-year primary school students under the new Sports Act]. In *Športový edukátor, 11*(2), 3-11.

Šimonek, J., & Židek, R. (2019). *Talent in sport (selection, identification and development).* Ústí nad Labem: Jan Evangelista Purkyně University.

Troiano, R. P., Berrigan, D., Dodd K. W., Mâsse L. C., Tilert T., & McDowell M. (2008). Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise, 40*(1), 181–188.

van Beurden, E., Zask, A., Barnett, L. M., & Dietrich, U.C. (2002). Fundamental movement skills -how do primary school children perform? The 'Move it Groove it' program in rural Australia. *Journal of Science and Medicine in Sport, 5*(3), 244–252.

Views of Art Education Students on the Inclusion of Artworks in Art Education Lessons

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Abstract The standpoint which students of art education gain in the course of their studies can impact their later work as educators. A fundamental aspect of art education is the inclusion of artworks in art education lessons. The existing curriculum defines neither the artists nor the number of artworks to be showcased by art education teachers. Also, it does not define the time teachers should dedicate to discussing various artworks, as this is entirely their professional decision. The objective of this research, which focused on students in the third year of art education was to determine (a) what kind of experience with artworks inclusion the students gained during observational teaching practice, (b) which artworks the students find the easiest to show to and discuss with pupils in the second and third cycles of elementary school and to relate to the concepts from the curriculum, and (c) what response to the showcased artworks the students anticipated from pupils. We discovered that the experiences of the students included in our sample varied considerably and that the students considered the artworks combining various communication codes to be more appropriate for the inclusion in art education lessons in higher grades of elementary school.

Keywords: art education, relation to art education, teaching methods, contemporary art practices, multimodality.

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1 Introduction

Modern artworks -normally introduced to older pupils in art classes taught by an art teacher -frequently deviate from the traditional modes of expression. Contemporary art practices often incorporate various communication codes. Instead of using merely the visual code, they frequently include the elements of sound, text, or movement. Similarly, younger pupils are also introduced to modern modes of artistic expression to some extent (through school-organised visits to galleries and museums or in their leisure time). They should, however, learn about different modes of expression (not only the traditional ones) in art class as well. The art curriculum does in no way favour the traditional modes of expression, even though they are considered -with respect to the set art notions and the development level of pupils -crucial and hence strongly represented in the artworks normally shown to pupils in elementary school. With regard to the operative goals of art education, artworks are the key element used for learning art notions. "Through artworks produced by artists, creations produced by pupils and through models as seen in nature and the environment, pupils learn the notions related to sculpture" (Curriculum 2011, p. 10). A question that arises pertains to the selection of artworks to be shown to pupils. Surely one needs to consider that an artwork needs to be related to the set art task, that is, the theoretical artistic problem, the visual art technique, and the motif or theme -the idea of the work. According to Shulman Herz (2010), an artwork should incite pupils to think about a selected topic and be suited to their age; older pupils can deal with more difficult concepts, while younger pupils have no difficulties accepting non-figurative artworks. She further notes that the artwork must equally attract the teacher, as excitement is catchy and a dialogue can hardly develop unless it is led by an enthusiastic teacher (Shulman Herz, 2010). Enthusiasm for the artwork is a necessary, but not a sufficient condition for the integration of contemporary works of art into teaching. Teachers need competencies related to knowledge of professional subjects (studio subjects, art theory, art history, and so forth) and general pedagogical subjects (such as pedagogy, psychology).

A gradual incorporation of artworks by artists who have moved away from the traditional modes of expression and who include various communication codes could take pupils one step closer to modern visual arts. Zupančič (2006) devised a set of criteria for the selection of contemporary artworks which could be introduced to pupils: (a) the author and their work have been recognised by art historians as important, (b) the author is a typical representative of their art movement (the same applies to the artwork), and (c) the showcased artwork is explicit, deals with appropriate subject matter, and is suitable in terms of pupils' further artistic work. Introducing artworks that incorporate various communication codes allows pupils to recognise multimodality -different communication codes -in works of art. The older the pupils, the easier it will be for them to identify the meanings conveyed through different communication codes (for example, what information I get through sound, what the visual image is trying to convey, and how to combine both pieces of information together). This will in turn help children develop their multimodal literacy. In this day and age, multimodality has replaced monomodality in different areas.

> More recently, the dominance of monomodality has weakened, although it still persists in some practices, for instance in the writing and publishing of academic papers. The trend towards multimodality began with the avant-garde experiments of the early twentieth century, when 'concrete poetry' began to express itself not only through words, but also through typography, and when visual artists used new kinds of materials and sought to produce Gesamtkunstwerke which would combine as many forms of expression as possible. (van Leeuwen, 2017, p. 4)

Multimodal literacy is the ability to decode the message of multimodal works, that is, the ability to discern the meaning created by a combination of different communication codes. Jewitt (2008) identified the following communication codes: verbal (text), visual (how something appears), spatial (placement within space), gestural (body language), and audio (music, sound effects).

Whether a pupil can identify all the layers of an artwork, including its multimodal nature, depends on the teaching methods used by their teacher. When discussing artworks, the teacher needs to take into consideration that pupils will have different opinions on different artworks, which means they will experience and judge them differently. The teacher must also allow the pupils to appreciate each other and be tolerant (Berce-Golob, 1993). A dialogue on the artwork that allows open discussion between the teacher and the pupils on the motif or theme (idea), form (design and material), and context is a vital component of the method of visual and aesthetic communication and the method of multiplication and elaboration of artistic sensibility, which both derive from the specificity of aesthetic communication (Karlavaris, 1987). In addition, artwork discussion relates to the method of complexity and overlapping (Karlavaris, 1987), as one needs to take into consideration that an artwork is a conglomerate of various elements, namely, (a) motif (theme, idea), (b) art technique, style, design and art language (form), and (c) the personality of the author and social impact (context). Hubard (2010) distinguished between two types of dialogue when discussing artwork, predetermined dialogue and interpretive dialogue:

> Predetermined dialogue is helpful when the goal is to illuminate precise questions such as: How has this artist addressed a particular challenge? What was the original function of this object? What have art experts found significant in this artwork? Because the understanding students are to achieve is specific and pre-identified, the effectiveness of predetermined dialogue is relatively easy to assess. (Hubard, 2010, p. 42)

The predetermined dialogue is the most frequent form of conversation used in elementary school art education classes, as this has been indicated already within the curriculum (learning about art concepts through artworks). The interpretive dialogue, on the other hand, has a whole different character:

> In contrast to predetermined dialogue, interpretive dialogue is not meant to communicate pre-identified ideas, but rather enable students to construct their own meaning in response to an artwork. … Interpretive dialogue addresses the philosophical notion that the meaning of an artwork is not fixed but ever-evolving … (Hubard, 2010, p. 42)

Hubard distinguished between "two types of interpretive dialogue: (a) thematic and (b) open" (2010, p. 42). In a thematic dialogue, the teacher selects a topic, usually a more general one (for example, human relations), and uses carefully selected questions to direct pupils in their study of the artwork (Hubard, 2010). The essence of an open dialogue is in that it recognises an artwork as complex and multi-layered.

> … [A] fixed theme can limit the relevance that certain viewers might otherwise find in a particular work. In open dialogue, multiple avenues for inquiry emerge organically from the viewers' responses. The teacher does not come to the dialogue with a theme or a tight set of questions to ask. (Hubard, 2010, p. 43)

An open dialogue when it comes to discussing art is particularly important with respect to contemporary art practices. Desai (2002) noted that "art teachers need to move beyond the consideration of the physicality of the art object per se to a contextualized understanding of the object in terms of the social, political, economic, and cultural conditions of production and appreciation" (p. 318). One of the methods that helps pupils to identify multiple layers and the complexity of an artwork is the method of aesthetic transfer, developed by Duh and Zupančič (2013), the objective of which is to transfer the aesthetic message contained in an artwork to pupils in the course of art education practice. According to the authors, this method consists of three stages: perception, reception, and reaction (Duh & Zupančič, 2013). They further noted that the first phase aims at the child getting as clear perception of the artwork as possible (p. 75), while reception aims at children expressing the results of perception in words, thus becoming aware of them and internalising them (p.76). The last stage of the method of aesthetic transfer is reaction which the authors define as "individual productive response to an artwork" (Duh & Zupančič, 2013).

Shulman Herz (2010) underlined that the first contact with an artwork should be completely open, as any preliminary questions might lead to presuppositions that impact the child's interpretation. The author further outlined some vital elements of artwork observation: (a) setting the first question (What do you see? What have you noticed?), (b) pupils having sufficient time to observe the artwork in detail, (c) pupils discussing the artwork in pairs, so anyone gets their chance to speak, and (d) pupils making a list of 10 to 15 things they observed in the artwork. What follows is a set of interpretative questions (such as, what could have made the artist select this motif? Do you have any ideas on how the artist wanted to change the way people think?). Shulman Herz (2010) emphasised that it is always about hypotheses and guesses, where children need to base their ideas on what they have seen in the artwork (for example, what in the artwork made you come to this idea?).

One of the problems with this is definitely the time that is allocated to art education in elementary school. The basic activity of pupils in art classes is practical work. The artworks that a teacher decides to include in art lessons must adhere to curriculum goals. What children normally learn through artworks is the concepts related to art theory. Predetermined dialogue is the most suitable choice for this method of introducing artworks to children. However, two of the goals that are listed in the art curriculum under general goals are: (a) children develop their ability to form criteria for the evaluation of artwork and general visual art problems of the environment, and (b) children develop a sensitivity towards art cultural heritage and cultural diversity (Curriculum, 2011, p. 4). To attain these goals, one must resort to interpretive dialogue which is normally more time consuming. At the same time, it allows pupils to form their personal response to the artwork. The interpretive dialogue is particularly important with contemporary art practices which include elements of multimodality and require a step back from the usual practice of artwork observation and discussion.

Which artworks art teachers will choose, how they will discuss the art with their pupils, and how much time they will dedicate to artwork discussion may as well depend on practical experience these teachers have gained in the course of their studies, the views they hold on specific artworks, the age of pupils they teach, and so on.

2 Methods

2.1 The research problem and research questions

The objective of this survey was to collect the views of art education students on specific artworks (the focus was on both traditional and contemporary art forms) with particular regard to their possible inclusion into art classes.

(1) What kind of experience with showcasing artworks in classroom have the students gained in the course of their observational teaching practice?
(2) Which of the showcased artworks do they find the easiest to show to and discuss with children (in the second and third cycles of elementary school), and relate to the notions from the art curriculum?

(3) What do the interviewees feel would be the attitude of the children towards the showcased artworks?

2. 2 Survey sample

This survey included all students in their third year of the first-cycle Art Education programme (convenience sample). An electronic survey was sent to a shared e-mail of the students. The request for taking part in the survey was received by 16 students, all of which agreed to participate. The questionnaire was fully completed by 14 students, while two of them failed to provide answers to two parts of the questionnaire. As regards the gender of the survey sample, all respondents were female students (there are no male students in this particular year). The majority of the students in the sample is aged 21 (62.5 %), followed by 22 (18.8 %), 23 (12.5 %), and 24 (6.3 %).

2.3 Data collection and processing

In November 2019 a questionnaire which included a five-point Likert scale was developed; it was used to determine how the respondents perceived the information they gained on various artworks discussed in class in the course of their observational teaching practice. The second part of the questionnaire included two artwork reproductions and a video, followed by ten statements regarding the three artworks and possible answers (*I strongly disagree*, *I disagree*, *I do not know/cannot decide*, *I agree*, *I strongly agree*). The participation in the survey, which was conducted in November 2019, was voluntary and anonymous. The data were analysed at the level of descriptive statistics.

In this survey I used the following artworks, according to their different modes of communication:

(1) Henri Matisse, *The Goldfish*[1], 1911. Henri Matisse (1869–1945) was a French artist who is considered to be one of the greatest artists of the twentieth century. Crepaldi described *The Goldfish* as follows:

[1] Photo available at https://www.henrimatisse.org/goldfish.jsp (July 11, 2019).

> The motif of a vase with red fish is in many paintings by Matisse almost always placed in the forefront. The reflections of fish in the water are surrounded and highlighted by sparkly colours of flowers and leaves in the garden. The entire composition plays with elliptical and circular movements, repeated through and reinforced by the round table. (Crepaldi, 1998, p. 57)

(2) Peter William Holden, *SoleNoid,* 2009, an audio-visual robotic installation (Holden, n.d.). Holden says about his work that he is exploring ways of dissolving the boundaries between cinematography and sculpture. He notes:

> In my recent investigations of this theme, I've been working with computational devices combined with robotic elements to create mandala-like kinetic sculptures. I consider these kinetic sculptures to be solely the medium I work with and just the first step in the process to achieve what I believe is the true focal point of my work. That focal point being the ephemeral animations - choreographies that are created when these sculptures are in motion. (Archive of Digital Art, para. 1)

Holden's installation comprises eight robotic arms, each holding a tap shoe that can move in various directions (toe tap, heel tap, etc.). Holden elaborates: "Each movement produces its own characteristic sound. The sculpture alternates between … a preprogrammed composition by Marko Wild" and the sound produced through interaction with the audience that can play the installation via the keyboard placed next to it. "Hitting one of the teardrop-shaped keys on the keyboard triggers a short sequence of movements and functions similarly to a sequencer. These sounds and movements can effortlessly be patched together by the audience to produce a new composition" (Holden, n.d.).

(3) Sašo Vrabič, *Portret Erika*, 2016 – 2017, oil on canvas. The portrait of Erik by a contemporary Slovenian artist Saša Vrabič is a commissioned artwork composed of words. According to Ivančič Fajfar, the piece incorporates an intervention of the person portrayed: the inscriptions are taken from a notepad in which Erik kept record of his daily events for a month. Sašo Vrabič skilfully turned the child's handwriting into a font, which was then used on a slightly toned white underpainting to draw/write out a convincing portrait (Ivančič Fajfar, n.d.).

4 Results and discussion

4.1 Experience with showcasing artwork reproductions in the classroom

The first set of questions was answered by all students (*n*=16). The students generally noted that they had learned many new things during the course of their observational teaching practice. As much as 50 % of the respondents agreed and 43.8 % strongly agreed with the respective statement. As regards the statement "The teacher showed many different artwork reproductions over the course of the practical training", the opinions were split. Over a third of the respondents disagreed (37.5 %) or strongly disagreed (6.3 %) with that statement, nearly a third (31.3 %) did not know or could not decide, while one fourth of the respondents agreed with it (25 %). The students included in the sample completed their observational teaching practice at different schools, therefore they had different art teachers as mentors. The number of showcased artworks and the time dedicated to artwork discussion is entirely in the hands of educators and thus, various practices are used.

Over one half of the respondents (56.3 %) disagreed with the statement that the teachers had shown at least one quality artwork reproduction per art class, while nearly a third of them (31.3 %) agreed with the statement. A minor share of the students (12.5 %) did not know or could not decide. Further, half of the students agreed (37.5 %) or strongly agreed (12.5 %) with the statement that the art teacher had conducted art lessons nearly without including artwork reproductions, and one fourth (25 %) did not know how to answer or was unable to decide. A good fourth of the students, on the other hand, disagreed (18.8 %) or strongly disagreed (6.3 %) with the statement. We can conclude, based on the results, that the students have seen different practices during their observational teaching practice – from teachers who did include artworks in art education lessons to those that paid no particular attention to artworks.

As regards the statement "The teacher showcased artworks reflecting contemporary art practices (installations, videos, etc.) in higher grades (eighth and ninth)", the majority of the students replied with I do not know/cannot decide (43.8 %), while roughly the same proportion of them disagreed (37.5 %) or strongly disagreed (6.3 %) with it. A minor share of the respondents (12.4 %) agreed with the fact that the teachers in higher grades also used artworks reflecting contemporary art practices.

One quarter of the students (25 %) disagreed with the statement that the teacher had shown artwork reproductions which were based predominantly on traditional art forms, while a greater proportion of the students disagreed with the statement (37.5 %) or did not know/could not decide (37.5 %). That leads to a conclusion that those teachers who did, in fact, showcase artworks in class, mostly resorted to artworks using traditional modes of expression and only rarely to artworks reflecting contemporary art practices. The answers of the students are such one would expect, given that for pupils to develop a relationship with visual arts, they need to be introduced to various artworks (considering time, space, mode of expression, etc.).

The statement "The teacher encouraged the pupils to give their opinion and discuss the artwork while observing it" also revealed much diversity of opinion. Half of the respondents disagreed (43.8 %) or strongly disagreed (6.3 %) with the statement. Over a third (37.5 %) of the respondents agreed with it and only a minor share (12.5 %) did not know or could not decide on whether or not the teacher encouraged the pupils to give their opinions and join the discussion. A large proportion of the respondents agreed (37.5 %) or strongly agreed (6.3 %) with the statement that the teacher directed students largely to a discussion about visual art elements. Nearly a quarter disagreed (18.8 %) or strongly disagreed (6.3 %) with that. Nearly a third of the respondents (31.3 %) did not know the answer or could not decide on this matter. The collected responses indicate that teachers encouraged the pupils to focus primarily on the formal aspects of the artworks rather than on giving their opinions. The responses are hardly surprising, as it is observed in practice that art education in elementary school has been losing its educational value.[2]

4.2 Henri Matisse, *The Goldfish* (1911)

The set of questions regarding the artwork by Henri Matisse was answered by 15 students (*n*=15).

[2] Possible causes might lie in numerical school grades and the *Nacionalno preverjanje znanja* (NPZ) [National Assessment of Knowledge] examination. The latter focuses on testing the knowledge of art-theory related concepts, which is easier to assess (see https://www.ric.si/mma/N191-551-3-1/2019061310502833/). In the future, it would make sense to analyse positive and negative effects of the NPZ examination on the way art education classes are conducted in elementary school.

Table 1: Henri Matisse, The Goldfish, 1911

Henri Matisse, *The Goldfish*, 1911	I strongly disagree.		I disagree.		I do not know / cannot decide.		I agree.		I strongly agree.		TOTAL	
	F	*f%*	*F*	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*
I could easily show this artwork to students in the second cycle.	0	**0%**	0	**0%**	0	**0%**	15	**100%**	0	**0%**	15	**100%**
I could easily show this artwork to students in the third cycle.	0	**0%**	0	**0%**	1	**6.7%**	12	**80%**	2	**13.3%**	15	**100%**
I could easily discuss this artwork with students in the second cycle.	0	**0%**	0	**0%**	2	**13.3%**	12	**80%**	1	**6.7%**	15	**100%**
I could easily discuss this artwork with students in the third cycle.	0	**0%**	0	**0%**	0	**0%**	13	**86.7%**	2	**13.3%**	15	**100%**
I could easily relate this artwork to the concepts from the second cycle curriculum.	0	**0%**	0	**0%**	5	**33.3%**	10	**66.7%**	0	**0%**	15	**100%**
I could easily relate this artwork to the concepts from the third cycle curriculum.	0	**0%**	0	**0%**	3	**20.0%**	11	**73.3%**	1	**6.7%**	15	**100%**
Students of the second cycle could not relate to this artwork.	0	**0%**	11	**73.3%**	4	**26.7%**	0	**0%**	0	**0%**	15	**100%**
Students of the third cycle could not relate to this artwork.	0	**0%**	10	**66.7%**	4	**26.7%**	1	**6.7%**	0	**0%**	15	**100%**
This piece is a regular example of an artwork that can be shown to students in the second cycle.	0	**0%**	1	**6.7%**	7	**46.7%**	6	**40.0%**	1	**6.7%**	15	**100%**
This piece is a regular example of an artwork that can be shown to students in the third cycle.	0	**0%**	1	**6.7%**	7	**46.7%**	6	**40.0%**	1	**6.7%**	15	**100%**

The results in Table 1 indicate that the students could show *The Goldfish* by Henri Matisse to pupils in the second and third cycles of elementary school without reservations and do not expect any problems discussing the artwork with the class. Most of the respondents feel they could easily relate this artwork to the notions from the art curriculum. Over half of the respondents believe that pupils would be able to relate to this artwork. Nearly half of the respondents, however, could not decide whether this artwork was a typical example of artworks that are normally shown to pupils in the second and third cycle of elementary school. This has been expected, as *The Goldfish* is a figural work with a motif that children can relate to. Furthermore, he students could easily recognise the formal features in this artwork, such as colour, colour relations, and composition. It is therefore not surprising that they could relate it to the curriculum.

4.3 Peter William Holden, *SoleNoid,* an audio-visual robotic installation (2009)

Table 2: Peter William Holden, an audio-visual robotic installation (Sole Noid, 2009)

Peter William Holden, an audio-visual robotic installation (*SoleNoid*), 2009	I strongly disagree.		I disagree.		I do not know / cannot decide.		I agree.		I strongly agree.		TOTAL	
	f	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*
I could easily show this artwork to students in the second cycle.	0	**0.0%**	7	**43.8%**	3	**18.8%**	6	**37.5%**	0	**0.0%**	16	**100%**
I could easily show this artwork to students in the third cycle.	0	**0.0%**	1	**6.3%**	3	**18.8%**	9	**56.3%**	3	**18.8%**	16	**100%**
I could easily discuss this artwork with students in the second cycle.	0	**0.0%**	7	**43.8%**	3	**18.8%**	6	**37.5%**	0	**0.0%**	16	**100%**
I could easily discuss this artwork with students in the third cycle.	0	**0.0%**	2	**12.5%**	2	**12.5%**	11	**68.8%**	1	**6.3%**	16	**100%**
I could easily relate this artwork to the concepts from the second cycle curriculum.	0	**0.0%**	6	**37.5%**	5	**31.3%**	5	**31.3%**	0	**0.0%**	16	**100%**
I could easily relate this artwork to the concepts from the third cycle curriculum.	0	**0.0%**	2	**12.5%**	3	**18.8%**	10	**62.5%**	1	**6.3%**	16	**100%**
Students of the second cycle could not relate to this artwork.	0	**0.0%**	4	**25.0%**	4	**25.0%**	8	**50.0%**	0	**0.0%**	16	**100%**
Students of the third cycle could not relate to this artwork.	0	**0.0%**	7	**43.8%**	5	**31.3%**	4	**25.0%**	0	**0.0%**	16	**100%**
This piece is a regular example of an artwork that can be shown to students in the second cycle.	0	**0.0%**	14	**87.5%**	2	**12.5%**	0	**0.0%**	0	**0.0%**	16	**100%**
This piece is a regular example of an artwork that can be shown to students in the third cycle.	0	**0.0%**	7	**43.8%**	6	**37.5%**	3	**18.8%**	0	**0.0%**	16	**100%**

The results in Table 2 show that a good half of the respondents had no reservations showing the artwork by Peter William Holden, *SoleNoid*, to pupils in the third cycle of elementary school, but not to pupils in the second cycle. Similarly, half of them feel they could easily discuss it with pupils in the third cycle but expect difficulties with pupils in the second cycle. As for the correlation between the artwork and the curriculum, the results were rather similar. There were interesting answers pertaining to students' opinion on whether or not children could relate to this artwork. While a half of them believe that pupils in the second cycle could not relate to this artwork, only a quarter of the respondents assume the same for pupils in the third cycle of elementary school. Most of them opposed the statement that this was a typical example of artworks normally shown to pupils in the second cycle of elementary school, whereas the proportion of those that felt this was not an artwork typically used with pupils in the third cycle was under a half. Based on their answers, it is safe to assume that the artwork could be used with older pupils (in the third cycle) with less difficulties. The artwork in question represents a major departure from traditional modes of expression, as it incorporates movement and sound and is thus more difficult to analyse through discussion. A conversation about visual elements and materials used is certainly not sufficient, so the teacher should plan an interpretive dialogue that would encourage critical thinking and allow pupils to express their opinions.

4.4 Sašo Vrabič, *Portret Erika*, 2016 – 2017

Table 3: Sašo Vrabič, Portret Erika, 2016 – 2017

Sašo Vrabič, *Portret Erika*, 2016 – 2017	I strongly disagree.		I disagree.		I do not know / cannot decide.		I agree.		I strongly agree.		TOTAL	
	f	*f*%	*f*	*f*%	*f*	*f*%	*f*	*f*%	*f*	*f*%	*f*	*f*%
I could easily show this artwork to students in the second cycle.	0	**0.0%**	0	**0.0%**	3	**20.0%**	12	**80.0%**	0	**0.0%**	15	**100%**
I could easily show this artwork to students in the third cycle.	0	**0.0%**	0	**0.0%**	0	**0.0%**	14	**93.3%**	1	**6.7%**	15	**100%**
I could easily discuss this artwork with students in the second cycle.	0	**0.0%**	0	**0.0%**	5	**33.3%**	10	**66.7%**	0	**0.0%**	15	**100%**
I could easily discuss this artwork with students in the third cycle.	0	**0.0%**	0	**0.0%**	1	**6.7%**	13	**86.7%**	1	**6.7%**	15	**100%**
I could easily relate this artwork to the concepts from the second cycle curriculum.	0	**0.0%**	1	**6.7%**	8	**53.3%**	6	**40.0%**	0	**0.0%**	15	**100%**
I could easily relate this artwork to the concepts from the third cycle curriculum.	0	**0.0%**	0	**0.0%**	3	**20.0%**	11	**73.3%**	1	**6.7%**	15	**100%**
Students of the second cycle could not relate to this artwork.	0	**0.0%**	7	**46.7%**	6	**40.0%**	2	**13.3%**	0	**0.0%**	15	**100%**
Students of the third cycle could not relate to this artwork.	0	**0.0%**	12	**80.8%**	3	**20.0%**	0	**0.0%**	0	**0.0%**	15	**100%**
This piece is a regular example of an artwork that can be shown to students in the second cycle.	0	**0.0%**	5	**33.3%**	8	**53.3%**	2	**13.3%**	0	**0.0%**	15	**100%**
This piece is a regular example of an artwork that can be shown to students in the third cycle.	0	**0.0%**	3	**20.0%**	7	**46.7%**	5	**33.3%**	0	**0.0%**	15	**100%**

The students' responses the artwork *Portret Erika* by Saša Vrabič were similar to those for the artwork by Henri Matisse (see Table 3). The students had no reservations about showing this particular artwork to pupils in the second and third cycles of elementary school. Over half of the respondents felt they could discuss the artwork with pupils in the second cycle without difficulties (though one third did not know or could not decide on this question). In regard to the pupils in the third cycle, most of the respondents agreed or strongly agreed that they could easily discuss this artwork with them. There was slightly more difference in opinion as regards relating the artwork to curriculum goals. Over a half of the respondents chose *I do not know/cannot decide* with the statement "I could easily relate this artwork to the concepts from the second cycle curriculum" (though a large share of them agreed with it). On the other hand, the majority of the respondents thought they could easily relate this artwork to the concepts from the third cycle curriculum. Nearly a half of them opposed the idea that pupils in the second cycle could not relate to this artwork, and the majority disagreed with this statement with respect to pupils in the third cycle. There was a considerable difference in opinion regarding whether or not this artwork was a typical example of artworks shown in the second and third cycles of elementary school. Although this artwork incorporates both image and text, which makes it less common compared to traditional modes of expression, the students had no reservations as pertains to showing it to pupils in the second and third cycles of elementary school and discussing it with them. Some problems may appear only with regard to relating the artwork to curriculum goals. It can be assumed that the students found the artworks which combined various communication codes (the second and the third artwork in the survey) intuitively more appropriate for older pupils.

Conclusion

The experience which students of art education gain in the course of their studies and their viewpoints derived therefrom can have a significant impact on their future work as educators. How they will include artworks in their classes, prepare for and execute the discussions about artworks depends also on the models they have been introduced to during their studies (both as part of their observational and integrated teaching practice). The replies provided by the students indicate that the experience with artwork inclusion, which they gained through observational teaching practice, varies considerably. However, the students do see the potential in including the artworks showcased in this survey, in art lessons. An observation worth mentioning is that they consider the two artworks that combine several communication codes (word, sound, movement) to be more appropriate for art lessons in higher grades of elementary school. Owing to a small survey sample, the results can by no means be generalised. However, they can be used as a starting point for further research regarding the inclusion of artworks in art lessons. A problem arises in the sixth grade and the entire third cycle when the number of art lessons gets halved. The teaching methods (see Berce-Golob, 1993; Duh & Zupančič, 2013; Hubard, 2010; Karlavaris, 1987; Shulman Herz, 2010) that consider introducing artworks and artists in class require a certain amount of time which art teachers do not have (anymore).

References

Archive of Digital Art (ADA). *Peter William Holden – artist profile.* https://www.digitalartarchive.at/database/artists/general/artist/holden.html

Berce-Golob, H. (1993). *Likovna vzgoja. Načini dela pri likovni vzgoji: priročnik za učitelje na predmetni stopnji osnovne šole* [Art education. Methods of work in art education: A manual for teachers at the elementary level of elementary school]. DZS.

Crepaldi, G. (1998). Matisse: slepeči blesk fovističnih barv.[*Matisse: master of pure colours, his life and paintings*] Ljubljana: DAG Grafika.

Desai, D. (2002). The ethnographic move in contemporary art: What does it mean for art education? *Studies in Art Education*, *43*(4), 307–323.

Duh, M., & Zupančič, T. (2013). Likovna apreciacija in metoda estetskega transferja [Art appreciation and the method of aesthetic transfer]. *Revija za elementarno izobraževanje*, *6*(4), 71–86.

Holden, P. W. (n.d.). *SoleNoid audio-visual installation.* https://www.peter-william-holden.com/artwork.html

Hubard, O. M. (2010). Three modes of dialogue about works of art. *Art Education*, *63*(3), 40–45.

Ivančič Fajfar, M. (n.d.). *Sašo Vrabič: Portret Erika* [Sašo Vrabič: Portrait of Eric]. https://artis.si/SasoVrabicPortretErika/SasoVrabicPortretErika.html

Jewitt, C. (2008). Multimodality and literacy in school classrooms. *Review of Research in Education*, *32*(1), 241–267. https://doi.org/10.3102/0091732X07310586

Karlavaris, B. (1987). Problemi učnih metod pri likovni vzgoji [Problems of teaching methods in art education]. *Sodobna pedagogika*, *38*(3/4), 179–183.

Shulman Herz, R. (2010). *Looking at art in the classroom: Art investigations from the Guggenheim Museum*. Teachers College Press.

Učni načrt, Likovna vzgoja. [*Curriculum, Art Education.*] (2011). [PDF file]. Retrieved from http://www.mizs.gov.si/

Van van Leeuwen, T. (2017). Multimodal literacy. *Viden om Literacy*, *21*, 4–11. https://www.videnomlaesning.dk/media/2127/21_theo-van-leeuwen.pdf

Zupančič, T. (2006). *Metoda likovnopedagoškega koncepta: priročnik za učitelje* [The method of visual art pedagogical concept: A teacher's manual]. Ljubljana: Zavod RS za šolstvo.

THE NOVEL AND THE FILM *WONDER*

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Abstract This paper is an analysis of a literary work and a secondary media, a film, using the example of the children's novel *Wonder* by R. J. Palacio. The author published her novel *Wonder* in 2012 (in the US). A full-length film with the same title (*Wonder*) premiered in November 2017. The paper discusses the children's novel -a bestseller that received numerous awards (their official website lists about 50 awards by the end of 2015, which the book either received or was shortlisted for) and was translated into multiple languages -and the film adaptation, taking into account the basics of intermediality, narrativity, and reception theory. *Wonder* is a novel and a film discussing social and family relations that promote empathy, or, as headmaster Tushman says in his speech at the end of the school year, always trying to be a little kinder than is necessary.

Keywords:
Wonder,
empathy,
literature,
media,
R. J. Palacio.

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1 Introduction

The article presents an analysis of the literary work and its transfer to a second medium, film, which is one of the options for discussing literature and (other) media as component parts of culture and arts education. The primary interest of this analysis is in the differences between the book (the language mode) and the film which uses several codes of communication, and in how the film presents the narrative through various codes of communication, that is what was said in the film (everything that is included in the language code) and what was presented visually or acoustically. The analysis also deals with the question of how much of the original story was kept in the film.

The novel Wonder was the fourth most-sold novel on Amazon in 2017 (following the film premiere, more than five million copies were sold in the United States alone[1]). The work received numerous awards; the official website lists approximately fifty awards that the book received or was shortlisted for by the end of 2015 (the data has not been updated). By the end of 2015, the novel was published in more than forty countries around the world. The most surprising fact is that the novel Wonder is the author's debut. She explained that she wrote the novel after meeting a child similar to Auggie. She had made a mess of the meeting: her younger son was scared of the child, so she took both her children and left instead of speaking to the child and setting a good example. She explained: "It made me wonder what it must be like for that child, facing a world every day that doesn't know how to face you back." (About the author, n.d.) The author also disclosed that she picked the name August for the main character because she likes the name, and she gave August the last name of one of her favourite children's book authors, Philip Pullman. The novel was the inspiration behind the campaign Choose Kind. It stems from the quote by an American psychologist, dr. Wayne W. Dyer (1940–2015), who famously wrote, "When given the choice between being right and being kind, choose kind."

[1] The data was collected from the novel's Wikipedia article (Wonder [Palacio novel], n.d.). Based on the data collected from WorldCat (on July 7, 2019), 183 editions of this novel have been published so far, including 99 English-language editions, 14 French editions and 12 Chinese-language editions. The data also includes one Slovenian edition (translated in 2014 by Boštjan Gorenc – Pižama).

For the comparative analysis of the novel and film, the children's novel *Wonder* was selected; the novel became the source for the motion picture with the same title. It was written by R. J. Palacio, whose full name is Raquel Jaramillo Palacio. Her official website (About the author, n.d.) states: "A first generation American (her parents were Colombian immigrants), Palacio was born on July 13, 1963 in New York City. Her birth name is Raquel Jaramillo (Palacio was her mother's maiden name)." Palacio is an author and a graphic designer specializing in book cover design. She has also illustrated a number of her own stories, including a Peter Pan retelling. Palacio has published multiple literary works, among which the novel discussed here is the most important. In addition to *Wonder*, Palacio has published three more books about August Pullman: *365 Days of Wonder: Mr. Browne's Book of Precepts* (August 2014), *Auggie & Me* (October 2015), which "includes print editions of the original e-book novellas: *The Julian Chapter*, *Pluto*, and *Shingaling*. Palacio's newest work, a picture book called *We're All Wonders*, which she both wrote and illustrated, introduces Auggie -and the themes of kindness and empathy and tolerance -to younger children" (About the author, n.d., para. 4).

2 Method

The article presents the analysis of a literary work and a second medium, film, through the example of the children's novel *Wonder* by J. R. Palacio. The analysis of the novel includes the methodology of studying literature, which involves defining the topic, theme, motifs, (both main and secondary) characters, narrators, narrative perspective, structure, story, as well as literary time and space. The analysis of the film includes a multi-modal analysis of various codes of communication in the film (language code, gestural and symbolic codes, spatial code, and the acoustic code of communication) and the method of micro-analysis of the film, that is its structure (scene analysis) and its narration. The method of comparing the literary work and the film rests on the theory of intermediality. The concluding part of this article, while taking into account the reception theory (and especially the reception abilities of young readers), presents the opportunity for developing the students' social sensibilities while discussing the novel and the film.

3 Results

The basic message of the novel and film Wonder, accepting diversity, speaks to all generations of children and adults. A reflection on the story from the novel and the motion picture demands a simultaneous reflection on human (or rather, the readers' or viewers') values and interpersonal relationships. The campaign Choose Kind, which was formed on the basis of this novel, is aimed at publishers, teachers, parents, and young readers who discuss the story at school (a part of it is aimed specifically at teachers) or read it at home (it includes incentives to read the novel in the community).

3.1 The novel *Wonder*

The main literary character of the novel is ten-year-old August Pullman (whose birthday is October 10). Everyone calls him Auggie. He is an intelligent boy who loves natural sciences and space and is a big fan of George Lucas' *Star Wars*. This iconic series of films is referred to throughout the story, establishing an intermedial relation between the novel and the films (especially with the fifth part of the series, *The Empire Strikes Back*). At the beginning of the novel, he explains about his appearance (Palacio, 2014, p. 3): "I won't describe what I look like. Whatever you're thinking, it's probably worse."

The novel is divided into eight chapters which are titled after the literary character who functions as the first-person narrator of that chapter. Thus, Chapters 1, 6, and 8 have the title "August", Chapter 2 is titled "Via", Chapter 3: "Summer", Chapter 4: "Jack", Chapter 5: "Justin", and Chapter 7 "Miranda". The six first-person narrators cast light on the events from their own perspectives. The main theme of the novel -inclusive relationships -is presented synthetically, so that in places, the description of one event is repeated from another perspective. In most cases the narration from each of the characters allows the reader to fit together the pieces into a cohesive whole. Various narrators or literary characters describe the same event in different ways because their experience is different. Each character's narration is based on their own experience and their own perception of a certain event, which is why the literary characters are described indirectly -their characteristics are not presented upfront. Instead, readers can gather hints about their personalities based on what they describe, how they describe it, what they notice, what they emphasize, and so forth. August, his older sister Via, her boyfriend Justin, and Via's friend, Miranda, retrospectively talk about events that happened before the beginning of the novel -about August's birth, his illness, his anxiety from strangers' reactions to his face (which is the reason why Miranda bought him a space helmet; Justin remembers seeing him at the café), while August, Summer, and Jack describe the events that happened in school. Justin, Via's boyfriend, is a secondary literary character to whom other narrators (everyone but Summer) tell a secret, which allows the characters to solve misunderstandings and disagreements.

The main character of the novel is crucial in establishing interpersonal connections among other narrators. The relations between the literary characters show relationships, their actions and reactions, which is why they are the basic motifs of the novel.

In Chapter 1, August shows his feelings at his first contact with school and future schoolmates; the basic relationship between them is marked by what occurs on Halloween. August explains that he will dress up as Boba Fett from *Star Wars* but changes his mind in the morning and puts on The Bleeding Scream costume (no one recognizes him, so they freely and loudly gossip about him, which August hears; he is especially hurt by what his friend, Jack Will, says). His visit of his sister's school performance is also an important motif. In Chapter 8, two motifs are especially important: the incident at the camp (older children from another school attack August and Jack, but their schoolmates come to the rescue), where his schoolmates close ranks around him after he is bullied (the bullies call August "Gollum"), and the event at the end of August's first school year (with the principal's speech and the award).

In Chapter 2, Via (Olivia) explains the family tree (especially their father's parents, who were Jews from Russia and Poland, and their mother, who is Brazilian) and August's illness (the entire family carries the mutated gene, but it presented in August only). Via also summarizes the crucial event of Halloween, where August heard others talking about him, and convinces her brother to stay in school.

In Chapter 3, Summer explains why she became August's friend on the first day of school -she pitied him, thus she hung out with him, but soon realized that he was funny, kind, and smart (Palacio, 2014, p. 119): "He's just a kid. The weirdest-looking kid I've ever seen, yes. But just a kid." She is the character who unveils what *the plague* means (in the beginning, almost all August's schoolmates take part in the game; the game is played for the purpose of ignoring and teasing August with the rule of whoever touches him, he/she will become like August; this is a clear example of verbal violence). She is August's confidante, so he tells her why he does not want to spend any more time with Jack: on Halloween, Auggie heard Jack gossiping about him. Summer also gives Jack the hint: "The Bleeding Scream." (The Bleeding Scream is the mask that August wore on Halloween, and at the same time it is a metaphor for the ugly and for death.)

In Chapter 4, Jack reminisces about how he first met August (and thought his face was monstrous). He only finds out in December that, on Halloween, August overheard Jack saying nasty things about him. He then understands August's hurt feelings and sadness. Jack hits Julian, who called August a freak, then apologizes to August. They become friends once more. This triggers the boys' war, where they are ignored by almost all their schoolmates, started by Julian.

Justin, Via's boyfriend, learns three crucial bits of information in Chapter 5: Jack explains the boys' war to him, causing Justin to threaten Julian; Miranda confides in him that she and Via used to be friends and that she was the one who bought August the space helmet that he wore for two years, and that Via does not want to invite her family to the performance because everyone would gossip about August behind her back.

Miranda was Via's best friend who knew and accepted August since his birth. She changes her group of friends but later gets close to Via again (and even lets her have the main role in the school performance).

Some of the secondary literary characters, August's family -his mother, father, and sister, are extremely important. The sister sometimes feels left out because their parents must devote more time to Auggie, but she is also very understanding. Along with Via, some of the most important secondary characters are the first-person narrators, especially August's friends, Jack and Summer.

Jack Will and August meet before school even begins, when the school's principal, Mr. Tushman, asks three students to show August around the school (those roles fall to Jack, Charlotte, and Julian). Jack is the only one who remembers August from when they were little, because he got scared of him at the café. He first refuses to go to school and show August around. He changes his mind because of what his mother says (Palacio, 2014, p. 137): "Jack, sometimes you don't have to mean to hurt someone to hurt someone. You understand!" Soon, August's looks cease to bother him, and they become friends. Their friendship is first broken on Halloween (their schoolmates are gossiping about August, and Jack, who wants to be accepted, follows their example) but then deepens when Julian insults August, prompting Jack to fight him.

Summer is the kindest character and is never selfish or calculating. Her view on accepting diversity is very clear, which influences August a lot. She supports him throughout the story and even sits with him during their first lunch break. Together they form a "summer" table (Summer, August). Julian is the most negative character, a fact that August recognizes upon their first meeting. Julian pushes past August when they are visiting the school, and he almost falls (Palacio, 2014, p. 30): "'Oops, sorry about that!' said Julian. But I could tell from the way he looked at me that he wasn't really sorry at all." Soon after the school year begins, Julian asks August if he wears a braid like Jedi initiates from *Star Wars*; August confirms this and tells him his favourite character is Jango Fett. Julian then asks him:

> "'What about Darth Sidious?' he said. 'Do you like him?' […] Maybe no one got the Darth Sidious thing, and maybe Julian didn't mean anything at all. But in *Star Wars Episode III: Revenge of the Sith*, Darth Sidious's face gets burned by Sith lightning and becomes totally deformed. His skin gets all shrivelled up and his whole face just kind of melts. I peeked at Julian and he was looking at me. Yeah, he knew what he was saying." (Palacio, 2014, p. 44)

Julian is the boy who comes up with "the plague" and "the boys' war". He is the only one who does not accept August, not even at the end of the school year, and instead transfers to another school. Among other secondary characters, the principal Mr. Tushman and the teacher Mr. Browne are important as examples of acceptance:

the principal always acts correctly and gives an impactful end-of-the-year speech, while the teacher helps with his famous 'Mr. Browne's precepts'.

The literary space of the novel is New York City, specifically Manhattan. Important micro-locations include the Pullman family home, Beecher Prep School, and the nature camp at the Broarwood Nature Reserve in Pennsylvania.

The literary time is specifically limited; the story unfolds within one school year. It begins just before school starts and ends with the event at the end of the school year. August Pullman goes to fifth grade and is enrolled in regular schooling for the first time in his life. The novel's chapters include some inserted stories (mostly retrospective) that deal with August and feature the warm relationships in the Pullman family, confrontations with people who do not accept him, and similar. Chapter 1 (August) takes place from one week before school starts up until Halloween (including the holiday). Chapter 2 (Via) features a retrospective of her relationship with her brother, with Halloween and August's confession being the key events. Chapter 3 (Summer) takes us from the first day of school to Halloween. Chapter 4 (Jack) starts with the principal's call before school starts, instructing him to show August around the school, and ends in January, when the boys' war begins after the winter break, and includes a retrospective of his feelings from when he first saw August as a child. Chapter 5 (Justin) takes us from the beginning of the school year, when he meets Via, to the moment when the high school performance roles are distributed among students. Chapter 6 (August) starts in January and ends with the school performance (in May). Chapter 7 (Miranda) is mostly retrospective but also focuses on the school performance. Chapter 8 (August) focuses on the nature camp and the end-of-the-school event.

Based on its themes and motifs, *Wonder* is a contemporary children's novel with audience crossover potential -it is not intended to be read by young readers only. The author deals with issues of empathy, tolerance, and friendship, which are all connected to values.[2] Values are human beliefs (Schwartz, 1992, 2012) or rather criteria for judging behaviour, both our own and the behaviour of others (Licardo, 2016). The divide between values and personal characteristics is presented in two

[2] Shalom H. Schwartz (1992, 2012) argues that values are studied by all scientific disciplines that are human-focused. Those theories study values as criteria by which people choose and judge actions as well as accept people (including themselves) and events. Schwartz lists equality, the feeling of acceptance, and social power, which are the cornerstones of empathy, to be among universal values.

first-person narrators, Jack and Miranda. They are both friendly people, but they want to hang out with 'popular' schoolmates at certain times, so they ditch the friendships that they cultivated and valued. Jack likes August, yet he agrees with the antagonist, Julian, on Halloween, just to fit in. Miranda throws away her long-lasting friendship with Olivia. Both Jack and Miranda are very positive characters, so they learn from their mistakes, fix them, and renew their friendships.

The teachers of Beecher Prep School are good characters as well, among them especially the principal and the English teacher, Mr. Browne. The novel's appendix includes "Mr. Browne's Precepts" and "Postcard Precepts" (Palacio, 2014, pp. 311–313). All of Mr. Browne's maxims are collected in one place -each month, the teacher gives his students a basic idea on the basis of which they have to write an essay. The precepts are the baseline for the values and developing empathy throughout the novel; they include famous thoughts from important authors such as Confucius, Virgil, Sappho, John Donne, and James Thurber, the scientist Blaise Pascal, the cleric John Wesley, lines from a ballad called "Light and Day" by The Polyphonic Spree, an inscription on an Egyptian tomb, and words by a famous lecturer and author of numerous self-help books, Dr. Wayne W. Dyer. The latter wrote (quoted from Palacio, 2014, p. 311): "When given the choice between being right and being kind, choose kind." His idea was chosen for the aforementioned campaign, Choose Kind, that was inspired by *Wonder*.

Before the start of each chapter, the page which bears the name of the narrator also includes quotes, and snippets of song lyrics from popular hits (cited in order of appearance in the book): the songs "Wonder" by Natali Marchant, "Space Oddity" by David Bowie, "Beautiful" by Christina Aguilera, the novel *The Little Prince* by Antoine de Saint-Exupéry, the tragedies *The Elephant Man* by Bernard Pomerance, and *Hamlet* by William Shakespeare, and the songs "Beautiful Things" by Andain, and "Beautiful Child" by Eurythmics. Each quote showcases the personal characteristics of the narrator of each chapter. There is an intertextual relation between the chosen quotes and their placement in the novel; the quotes that are snippets of song lyrics also establish an intermedial connection to music.

August Pullman is presented at a crucial time in his life, when he first enters regular schooling, which is not easy. Despite being a gifted child, he is generally not well-accepted among his peers because of his appearance -most of his schoolmates participate in a game called *the plague*. The meanest of all schoolmates is Julian, though he loses all his friends by the end of the story (and transfers to another school). Peer bullying is mostly verbal (Julian's comments on August's looks, nasty messages that he writes to August and Jack), but also includes rejection and ignoring (the boys' war). Twice, physical violence erupts -when Jack hits Julian for calling August a freak, and at nature camp, when the older boys attack August and Jack but are stopped by August's school mates. This last fight is the key event after which August is accepted as an equal (Palacio, 2014, p. 282): "When I went back to school the next day, the first thing I noticed was that there was a big shift in the way things were. A monumental shift. A seizmic shift. Maybe even a cosmic shift."

At the end of the novel, the principal quotes Henry Ward Beecher, the school's namesake, in his speech (Palacio, 2014, p. 304): "Greatness […] lies not in being strong, but in the right using of strength … He is the greatest whose strength carries up the most hearts … […] by the attraction of his own." Then he continues: "Without further ado, this year I am very proud to award the Henry Ward Beecher medal to the student whose quiet strength has carried up the most hearts. So will August Pullman please come up here to receive this award?" August Pullman receives a standing ovation and is fully accepted in his environment, by his peers, for the first time in his life. On the way home from the event, his mother whispers (Palacio, 2014, p. 310): "You really are wonder, Auggie. You are a wonder."

3.2 Film *Wonder*

The film *Wonder* is a transfer of the novel *Wonder* into a second medium. It has a narrative basis which includes a presentation of human subjectivity; with this, Zorman (2009) warns that it is not enough to limit the film to pictures and literature to words.[3] Buchbinder (2011) and Bergala (2017) come to a similar conclusion, claiming that films cannot be observed simply from a linguistic perspective.

[3] Barbara Zorman mentions various film theories and cites the monograph *Novel into Films (The Metamorphosis of Fiction into Cinema)* by George Bluestone as one of the first works that systematically study film adaptations of literary works. She also mentions Christian Metz, Alexander Astruct, and Marie Claire Ropars as the founders of European film theory in the second half of the 20th century.

Wonder is a 2017 American comedy-drama film, directed by Stephen Chbosky and starring Jacob Tremblay (August), Millie Davis (Summer, one of Auggie's best friends), Noah Jupe (Jack Will, Auggie's best friend), Bryce Gheisar (Julian Albans), Julia Roberts (mother), Owen Wilson (father), Izabela Vidovic (August's sister), Mandy Patinkin (Mr. Tushman), Daveed Diggs (Mr. Browne). The screenplay was written by Jack Thorne, Steven Conrad, and Chbosky, and the music by Marcelo Zarvos and Bea Miller. The film score features several well-known songs, including Natalie Merchant's song "Wonder" (the song is played during the film's end credits). A quote from this song is also printed at the beginning of the novel.

The film does not expressly show the location of the events, nor are the locations named, with the exception of the Broarwood Nature Reserve in Pennsylvania and Coney Island, which are real geographic locations (this leads the viewer to assume that the Pullman Family lives in New York City). This gives the film a more universal appeal, as the story could have unfolded anywhere: at any school, beach, park, or street. Filming took place in several locations in British Columbia, Canada, and Coney Island, NY (the New York City skyline is recognizable). The film portrays the environment of a small elementary school that August goes to, and a large high school where his sister Olivia is enrolled (this second school space is shown as quite cold compared to the elementary school spaces). Clothing and footwear are used to show the economic status of the children; the relations between the rich (who pay steep tuitions and therefore probably believe they can get away with anything) and the less fortunate (who go to the private school because they receive scholarships). Emotions are mostly shown through facial expressions and gestures (the signs are quite straightforward, as this is a family movie). Understanding the characters is heavily influenced by the choice of the actors who portray them. Film logic dictates that all previews and trailers included Julia Roberts, who plays August's mother, in first place, even though August (who is played by a much lesser-known Canadian child actor, born in 2006) is the main character of the film.

The story unfolds chronologically, and the structure of the film is synthetic with a scenic perspective. It includes retrospective inserts of specific narrators; the inserted stories involve the personal viewpoint of the narrator on the main character or a certain event. Each narrator is announced with a title: Auggie, Via, Jack Will, and Miranda. Their inserted stories interrupt the synthetic story of the film, but they also complete it.

The first scene shows space and an astronaut in a spacesuit. The camera then pans over to a helmet and then to a child wearing a helmet who is jumping on the bed (his movements are similar to the astronaut's). The film begins with a first-person monologue by August, who introduces himself; the text is identical to the first chapter of the novel, which is told by the main character and bears the title "Ordinary." His story briefly touches on his birth, mentions the twenty-seven operations he's had, and focuses on exploring the school and the first school day. The film especially stresses August's interest in space -he wears a space helmet and has star stickers on his ceiling, the rug in his room has our solar system printed on it, and his pillow and bed covers feature a spacesuit.

The school environment focuses primarily on the principal, Mr. Tushman, the home room teacher, Mr. Browne, and the evil schoolmate, Julian Albans. On his first school day, Auggie arrives to school wearing a helmet. When kids look at him "like that", he imagines he is an astronaut, and everyone is applauding him. In Mr. Browne's class, when August makes his introduction, Julian asks him whether he wears the braid because he is a *Star Wars* fan. August confirms the fact and tells him his favourite character from the series is Jango Fett. Julian then asks him what he thinks of Darth Sidious; at that moment, the character from *Star Wars* is shown, so the viewers immediately understand Julian's nasty comment, even if they are not familiar with the film series. Chewbacca, another *Star Wars* character, always appears in the film when there is talk about diversity. August cuts his braid off in the evening and says he does not want to go to school anymore. His family is very understanding, they talk about everything, and his sister Olivia is always ready to comfort him.

Next up is Olivia's view of the events of the first school day -it is her first day of school as well, since she is starting high school. She realizes that Miranda does not want to be her friend anymore and she feels lonely. In the depths of her loneliness, when she thinks nobody cares about her anymore, Via goes to Coney Island, which she used visit with her late grandma. She remembers a very nice day they spent at the beach. On the first school day, she meets Justin. They soon become a couple and attend the drama club together.

Auggie's mother suddenly realizes she has a lot of spare time, because she used to take care of Auggie since his birth. She had also home-schooled him up until that year. She decides to finish the studies she had dropped because of August's illness. Then we see the photo shoot for August's class. At science class, August lets Jack cheat off his test, so Jack sits with him at lunch. They start to hang out together, which makes August's mom very happy. August's happiness is once again represented by a happy, jumping astronaut.

Daisy the dog destroys August's Boba Fett (a *Star Wars* character) costume for Halloween, so he puts on last year's costume, The Bleeding Scream. Since no one expects him to be wearing that costume, he overhears some gossiping at school, and runs back home. He hears Jack tell Julian that he would not be August's friend if August did not force him to, and that he would kill himself if he looked like August. Via comforts August and they go trick-or-treating together -Halloween has always been Auggie's favourite holiday. He no longer wants to be friends with Jack.

What follows is Jack Will's tale, which begins with the day when his mother convinces him to show the new schoolmate around because the principal asked him to. Jack remembers August from childhood and he soon realizes four things: that August is a great kid, that it is easy to get used to his face, that he is smart, and that he is funny. After Halloween, August does not let him sit at his table while Jack still does not understand why August is angry with him.

Summer joins August at his table because she wants to hang out with him and she does not approve of the way their schoolmates bully him (the plague).

Miranda gets the main role in the play, with Via as her substitute. Via is disappointed with Miranda because they are not friends anymore. At the same time, she is happy that Justin is now her boyfriend. Miranda is lonely as she no longer has Via, so she calls August, telling him she misses him and his entire family.

Miranda's narration is linked to memories of how happy and safe she felt with Via's family, and how she bought the space helmet for Auggie. Her own primary family is shown to be very cold (her parents are divorced, and her mother is an alcohol addict).

Next up is a scene where the kids go sledding; Summer and August are enjoying themselves, even though August still will not speak with Jack. Jack finds an abandoned sled -he later finds out that his rich schoolmate threw it away. He realizes he does not belong in the group of boys who hang out with Julian. During recess, he asks Summer to tell him why August will not be friends with him anymore. Summer mentions The Bleeding Scream in a whisper. Jack remembers what he said on Halloween and that he saw the mask of The Bleeding Scream in class for a moment. He connects the dots and finally understands why August is hurt. In science class, the teacher hands out science project assignments and tells Jack and August to work together. Julian says he could work with him; Jack resists the idea, so Julian asks him why he would want to cooperate with a freak. Jack attacks him and is suspended from school for two days (even though the principal knows he was defending his friend).

Miranda, now distanced from Via, realizes on performance day that she does not have anyone coming to see her perform. Even though she was supposed to play the main role, she lets Via have it, pretending she does not feel well. Via understands that this is a very unselfish act on Miranda's part, so they become friends again. The scene shows the conclusion of the performance, with Via's effective monologue on the meaning of being; Via performs it as though it was addressed to her mother. After the event, everyone gathers at the Pullmans': August, Via, their mother and father, as well as Justin and Miranda. All six of them are in a good mood, and the scene exudes friendliness, love, and peace.

August and Jack make the best science project -they present a camera obscura. This makes Julian like them even less.

The resolution of the film's story presents the meeting of Julian Albans' family with the principal; the mother is not concerned about the fact that her son had spent the entire school year causing grief to August -she feels that "such children" do not belong in school -and also to Jack. The parents decide there and then that they will enroll their son in a different school. Julian understands what he did was wrong and apologizes to the principal; he would like to remain at the school but his parents do not allow it.

The nature camp is especially important for the developing friendships among the schoolmates. When two older boys attack Jack and August, their schoolmates jump in to help. Trust and an inclusive relationship develop between them.

The last scene of the film shows the end-of-the-school event during which the principal awards August with the Henry Ward Beecher medal. Just before August walks up to the stage, his mother whispers to him that he really is a wonder. Chewbacca is standing on the stage next to the teachers. August's happiness is represented by a character dressed in a spacesuit.

4 Discussion and Conclusion

Wonder is a novel and a film about social and family relations that encourages empathy, or, as principal Tushman says in his end-of-the-year speech, the effort to be a bit nicer than is necessary. In *Wonder*, Auggie's teacher Mr. Browne presents a monthly precept, the first (in September) is the thought by Wayne W. Dyer about the choice between "right" and "kind". In her novel, Palacio used famous quotes from Virgil, Confucius, and Pascal, as well as an inscription from an Egyptian tomb, etc. She later presented them in more detail in the novel *365 Days of Wonder: Mr. Browne's Book of Precepts* (2014).

The comparison of the novel and the film shows some crucial differences in the representation of the story, which stems from the differences between the two mediums, or, as McFarlane (1996) states, that literature is entirely based on the verbal code while film includes verbal, acoustic, and visual codes. Compared with the film, the novel has multiple layers of motifs and themes, even though both versions share the narrative structure of the story and the film version (or transfer) includes the main motifs from the novel. The intermedial relation between the novel and the film does not only mean the work was transferred from one medium to another, but rather concerns the understanding and construction of multimodal messages that appear in each medium. Intermediality is a phenomenon where understanding the work in one art medium is crucial for understanding the work in a different medium (Juvan, 2000; Coats, 2018; Rek, 2019). The film is mostly focused on three themes: accepting diversity, peer violence, and the role of the family (with emphasis on the mother's role, likely because of the casting choices). There are fewer narrators in the film, and they are announced with titles: Auggie, Via, Jack Will, and Miranda. In the film, Summer and Justin are never narrators, and Charlotte's role is diminished. The inserted narrations of the four narrators are short, followed by the continuation of the story, without a break; the first-person narrator does not quit, but the perspective changes, moving from first-person to general. The novel presents the children's/teenagers' (the narrators') perspective, their feelings and understanding of certain events, while the film does not use the children's/teenagers' perspective as much -the story is much more linear. Music also has a significant impact in the film. The film music was not simply written as an accompaniment to each scene but rather paints emotions in each important event. The songs that were not written for the movie (and are well-known, popular hits), are also important, for example songs by Bruce Springsteen, Jacques Gauthe & The Creole Rice Jazz Band, Rupert Lang/Vancouver Children's Choir, and Bea Miller. The film does not use the songs that appear in the novel.

Vanesa Matajc (2011, p. 26) cites Johansen's (2002) four aspects of intermediality, which can be connected to the chosen novel and film: (1) the physiological aspect - the book belongs to the visual media and the film to the audio-visual media, (2) the physical aspect -both the novel and the film include language, while the film also includes music, space, gestures, symbols, and similar; this is the multimodal system of codes of communication, (3) the technological aspect -the book has written language in it, while the movie uses all the art forms, and (4) the sociological aspect -the novel and the film both emphasize empathy. A large part of intermediality in the book involves quoting or at least referencing bodies of work, such as well-known books, films (or film characters), rock ballads. Juvan (1999, p. 398) warns that "quotes only have communication value if the literary and cultural intertextual code is global or at least partially common to both the author and the readers." Further on are presented several obvious references.

There is a reference to the series of graphic novels, *Diary of a Wimpy Kid*, written and illustrated by Jeff Kinney (the first instalment was released in the US in 2007). August from *Wonder* is a bit younger than the main character Greg Heffley from the *Wimpy Kid* series. However, Greg too is experiencing something new: he is starting his freshman year of high school and he wants to prove himself; the stories take place in the school environment and represent adolescent troubles in a humorous way. The game called 'the plague' from *Wonder* (the schoolmates must not touch August and have to wash their hands quickly if they accidentally brush against him) is very similar to the game called 'Cheese Touch': if someone has Cheese Touch, they must not be touched and are stuck with it until they pass it on by touching someone else. The attitude of schoolmates towards Greg Heffley is thus very similar to the attitude of schoolmates towards August. Halloween is also mentioned in the *Wimpy Kid* books, even though it has a much more significant role in the novel *Wonder*. Both novels mention *The Wonderful Wizard of Oz* (1900), a children's novel written by author L. Frank Baum and illustrated by W.W. Denslow. Wonder also includes an intertextual reference to the novel *The Hobbit* (1937), which is a children's fantasy novel by the English author J. R. R. Tolkien, and an intertextual reference to the tale *The Ugly Duckling*, written by Hans Christian Andersen. At art class, the principal asks August why he drew a duckling during a class when they had to draw a self-portrait of themselves as an animal. The principal expected August to answer that he wanted to become a swan one day, but the boy answers that he resembles a duck.

There are references to popular music and the narrator's personalities, as well as references to excerpts from famous texts, which are used as the introductory motto in each chapter of the novel, and texts that are presented in the novel and the film as Mr. Browne's Precepts.

The story also includes references to the film series *Star Wars* by film director George Lucas; the first movie was made in 1977 and quickly became a worldwide pop-culture phenomenon. For the novel *Wonder*, two characters are especially important: Jango Fett (August's favourite character) and Darth Sidious (Julian compares August to him). The film *Wonder* also includes Chewbacca. The film also stresses the importance of references to space flights and astronauts.

Without understanding the intermedial connections, the (young) reader/viewer cannot understand certain parts of the text/film. Coats states:

> Intertextuality does not just refer to the practice of making specific allusions to other texts though that is part of its definition. However, it also refers to specific and nonspecific connections between texts and contexts that readers and viewers recognize on both conscious and unconscious levels. In other words, the sites of a text's production, form and audience response are webbed and mutually informing, so that we can never say that we are reading or viewing a straightforward, linearly conceived adaption of an

> original source text, and nor can we analyze it purely on those grounds. (Coats, 2018, p. 222)

Depending on the young readers'/viewers' reception capabilities, it is prudent to take into account their overall development, general knowledge, as well as the literary works and films that they know already, so that they can understand (construct) the multiple layers of the story and its message.

References

About the author J. R. Palacio. (n.d.). https://wonderthebook.com/about

Andersen, H. Ch. (2018). *Grdi raček* [The ugly duckling]. Ljubljana: Mladinska knjiga.

Bergala, A. (2017). Vzgoja za film: Razprava o poučevanju filma v šolah in drugih okoljih [Education for Film]. Ljubljana: Društvo za širjenje filmske kulture Kino!: Membrana.

Buchbinder, D. (2011). From 'Wizard' to 'Wicked': Adaptation theory and young adult fiction. In K. Mallan & C. Bradford (Eds.), *Contemporary children's literature and film: Engaging with theory* (pp. 127–146). London: Palgrave Macmillian.

Chbosky, S. (Director). (2017). *Wonder* [Film]. Lionsgate Films.

Coats, K. (2018). *The Bloomsbury introduction to children's and young adult literature*. London, New York: Bloombsbury Publishing Plc.

Diary of a wimpy kid by Jeff Kinney (n.d.). Wikipedia. https://en.wikipedia.org/wiki/Diary_of_a_Wimpy_Kid

Haramija, D. (2017). Vrednote v sodobni mladinski prozi [Values in contemporary children's prose]. *Otrok in knjiga*, *44*(99), 15–28.

Juvan, M. (1999). Medbesedilnost – figure in vrste [Intertextuality -figures and types]. *Slavistična revija*, *47*(4), 393–415. https://srl.si/ojs/srl/article/view/COBISS_ID-12026210.

Juvan, M. (2000). *Intertekstualnost* [Intertextuality]. Ljubljana: DZS.

Kinney, J. (2011). *Dnevnik nabritega mulca* [Diary of a wimpy kid]. Ljubljana: Grlica.

Licardo, M. (2016). *Teacher's role in child's introducing into social environment*. Maribor: Faculty of Education.

Lucas, G. (Director). (1977). *Star wars* [Film]. Lucasfilm Ltd.

Matajc, V. (2011). Literatura in elektronska komunikacija: intermedialnost sodobnega romana [Literature and electronic communication: The intermediality of the contemporary novel]. *Ars@Humanitas*, *5*(1), 25–39.

McFarlane, B. (1996). *Novel to film: An introduction to the theory of adaptation*. Oxford: Claredon Press.

Palacio, R. J. (2014). *Wonder*. London: Penguin Random House (Corgie books).

Rek, M. (2019). Media education in Slovene preschools: A review of focus studies. *Center for Educational Policy Studies Journal*, *9*(1), 45–60. https://doi.org/10.26529/cepsj.659

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. *Advances in Experimental Psychology*, *25*, 1–65.

Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online Readings in Psychology and Culture*, *2*(1), 1–20. https://doi.org/10.9707/2307-0919.1116

Star wars: The official site. https://www.starwars.com/.

Tolkien, J. R. R. (2000). *Hobit* [The hobbit]. Ljubljana: Mladinska knjiga.

Wonder (Palacio novel). (n.d.). Wikipedia. https://en.wikipedia.org/wiki/Wonder_(Palacio_novel)

Wonder Educational Planner (2019). Retrieved from https://wonderthebook.com/assets/downloadables/Wonder_EduPlanner14_WEB.pdf

Zorman, B. (2009). *Senca besede: Filmske priredbe slovenske literature (1948–1979)* [The shadow of the word: Film adaptations of Slovenian literature (1948-1979)]. Koper: Založba Annales.

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