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Environmental Content as a Part of Science-Oriented Sustainable Development Goals in Grades 6 and 7 of Slovenian Primary School: An Analysis of Science Textbooks

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Slovenian science education in Grades 6 and 7 (11- and 12-year-old students) of primary school focuses on the integration of various science subjects. According to the current Slovenian science curriculum, environmental concepts, as a part of science-oriented sustainable development goals, are an integral part of the subject of science. In 2026, a new science curriculum will be introduced in the education system to provide students and teachers with competences for sustainable development. Consequently, the aim of this study is 1) to analyse old (valid prior to the 2010/2011 school year) and current 6th and 7th-grade Slovenian science curriculum for primary school from an environmental and sustainability perspective, and 2) to investigate textual and pictorial material of four 6th grade and four 7th grade textbooks available for students in the current school year (2023/24) of primary school, that relate to environmental content, as well as their overall structure. The analysis of the textbooks showed that all textbooks explain some environmental topics recommended by the national curriculum. The text is supported by pictorial elements that present phenomena with realistic pictures on the macrolevel. The present study suggests that some environmental content is present in 6th- and 7th-grade science textbooks that are consistent with the learning goals of the curriculum but that a significant amount of sustainability content is missing. For this reason, the curriculum reform currently underway in Slovenia should more clearly include the implementation and thoroughly consider the integration of science-oriented sustainable development goals into the science curriculum in Grades 6 and 7.

Keywords: science curriculum, environmental competences, primary school, science education, sustainable development, textbook analysis

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Okoljske vsebine kot del naravoslovnih ciljev trajnostnega razvoja v 6. in 7. razredu osnovne šole v Sloveniji: analiza naravoslovnih učbenikov

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Naravoslovno izobraževanje v 6. in 7. razredu (učenci v starosti 11 in 12 let) osnovne šole v Sloveniji se osredinja na povezovanje različnih naravoslovnih predmetov. Po veljavnem učnem načrtu za naravoslovje so okoljski pojmi kot del naravoslovnih ciljev trajnostnega razvoja sestavni del predmeta naravoslovje. Leta 2026 bo v slovenski izobraževalni sistem uveden nov učni načrt za naravoslovje, ki bo vseboval tudi kompetence za trajnostni razvoj. Cilja raziskave sta: 1) analizirati stari (veljaven pred šolskim letom 2010/2011) in trenutni slovenski učni načrt za naravoslovje za 6. in 7. razred osnovne šole z okoljskega in s trajnostnega vidika; 2) raziskati besedilno in slikovno gradivo štirih učbenikov za 6. razred in štirih učbenikov za 7. razred osnovne šole, ki so na voljo učencem v tekočem šolskem letu (2023/24) in se nanašajo na okoljske vsebine, ter njihovo celotno strukturo. Analiza učbenikov je pokazala, da vsi učbeniki pojasnjujejo nekatere okoljske teme, ki jih priporoča trenutno veljavni učni načrt. Besedila v učbenikih so podprta s slikovnimi elementi, ki pojave prikazujejo z realističnimi fotografijami na makroravni. Raziskava nakazuje, da je nekaj okoljskih vsebin zajetih v naravoslovnih učbenikih za 6. in 7. razred osnovne šole, ki so skladni z učnimi cilji trenutno veljavnega učnega načrta, vendar manjka precejšnji del vsebin, ki se nanašajo na trajnostni razvoj. Načrtovana reforma učnih načrtov, ki trenutno poteka v Sloveniji, bi morala jasneje implementirati naravoslovne cilje trajnostnega razvoja v učni načrt za naravoslovje v 6. in 7. razredu osnovne šole ter podati smernice, kako te cilje realizirati pri pouku tega predmeta.

Ključne besede: učni načrt za naravoslovje, okoljske kompetence, osnovna šola, naravoslovno izobraževanje, trajnostni razvoj, analiza učbenikov

Introduction

Environmental issues have recently become one of the most emphasised topics as a result of globalisation, the media, and the impact of its consequences on people's daily lives (Laçin Şimşek, 2011). The realisation that environmental problems are related to human beings brings with it the need to raise individuals' awareness of the environment and the negative impact humans have on it. The agenda of the European Union and the United Nations now and in the near future is to create an adequate environment for future generations, focusing on sustainable development and a green transition. Following various guidelines (Bianchi et al., 2022; Mulvik et al., 2021; Rieckmann et al., 2017) to achieve the established goals, the school system worldwide is attempting to adapt to meet these criteria (Freire et al., 2016).

As Jimenez et al. (2017) report, environmental content is one of the most important dimensions of education for sustainable development. Nearly all levels of education, especially science education, promote either sustainable development or education for responsible citizens (Eilks, 2015), so when teaching the concept of sustainability in science education, a link should be made between science and sustainability concepts (Quinn et al., 2015). With the environmental competences acquired through environmental education, students take their place in society as citizens of the future to build a better future in a sustainable way (Erjavšek et al., 2021; Rauch & Steiner, 2013). Roczen (2011) defined environmental competencies as a model that describes the interconnectedness of environmental knowledge in relation to nature and a person's ecological attitudes and behaviour. Environmental competencies and sustainable development competencies are closely intertwined, often complementing each other within the broader framework of sustainable development (Agbedahin, 2019; Kopnina, 2020).

One of the basic educational materials that students need for learning school subjects is textbooks. They are usually the primary source of information and the most important educational resource of information for students' learning (King, 2010; Martin et al., 2011; Stará et al., 2017). Students use textbooks at school, for learning at home, and sometimes cite them as a reference for further work and projects that go beyond the national curriculum of a particular school subject (Gkitzia et al., 2011). In this context, science textbooks with environmental education concepts have great potential for learning about science-based sustainable development goals.

There are many definitions of a textbook, but the legal definition is contained in the Slovenian Regulation of Textbook Approval (*Pravilnik o*

potrjevanju učbenikov) from 2015 and states:

> The textbook is a basic learning material for achievement of educational aims and standards of knowledge, defined in the curriculum or in the catalogue of knowledge. It supports teaching and learning with didactic-methodical organization of content and adapted illustrations and graphical layout. The content and the structure of the textbook allow for independent learning of the participants of education and the acquisition of different levels and categories of knowledge. The textbook should not require any direct insertion of answers or solutions either written or drawn, save in the case of the textbook, designed for the use in electronic form (further e-textbook), that can allow for the direct insertion. The textbook is tied to the school subject or a topical-didactical set, grade and the level of education. A reader as a compendium of texts chosen in accordance with the aims of curriculum is also a textbook" (Regulation of textbook approval, 2015, Art. 2.1).

In order to be approved, the textbook must meet the conditions set out in the regulations cited above and is reviewed by experts from the individual subject areas.

The catalogue of approved textbooks is published by the Ministry of Education of the Republic of Slovenia and is available on the Ministry of Education's website. Many criteria have been published for the creation of textbooks in Slovenia (Devetak & Vogrinc, 2013), stating that a textbook should be comprehensible and transparent, that the pictorial elements should be of high quality, that the content should be in line with the objectives of the educational programme and be well-rounded, that the content should also be in line with the educational goals in the national curriculum of the subjects, that the textual and pictorial material should be scientifically accurate and promote the development of general and specific competences in the respective scientific field.

Ultimately, a textbook should promote active learning, include activities at various levels of knowledge and incorporate aspects of interdisciplinarity (Devetak & Vogrinc, 2013). In Slovenia, it is common for textbooks to be approved for the next school year every year. If there is more than one approved textbook for a subject, teachers are often faced with the dilemma of which textbook to use. They should choose the textbook that will help them the most in the classroom and with which they can achieve the learning objectives. Kalin (2004) presents six basic factors that should influence the choice of teaching materials or textbooks: 1) purpose and objectives of teaching, 2) learning content, 3) teaching methods and approaches, 4) characteristics of the social

environment, 5) characteristics of the students and the teacher, and 6) characteristics of the educational material itself. Finally, the textbook is an important element for all participants in the conventional classroom-centred learning environment (King, 2010). In such a conventional classroom-centred learning environment, textbooks enable teachers to achieve the objectives set out in the curriculum and guide them in their teaching (Martínez-Gracia et al., 2006). With the rapid development in information and communication technology and with the transition to online teaching triggered by the Covid-19 pandemic, learning and teaching have inevitably evolved from a traditional, classroom-based, textbook-centred process to a more flexible, e-learning-resource-oriented learning one (Dunn et al., 2022; Lau et al., 2018).

Research has often provided inconclusive results regarding students' preferences for digital textbooks compared to print textbooks and their achievement (Johnston & Salaz, 2019). by Roberts (2021) showed that students were equally successful when using e-textbooks or paper textbooks. Paivio (1991) presented a dual coding theory that explains two ways of taking in information while learning certain content: verbal associations and visual imagery. The visual system deals with the processing of graphic information, while the verbal system deals with the processing of linguistic information. Paivio's theory states that both verbal and visual information are used to represent information (Paivio, 1991; Sternberg, 2003). Based on these assumptions, Paivio suggested that learners have twice the chance of acquiring the information if it is encoded both visually and verbally, as the information is physically presented as a whole. According to this theory, textbooks that promote learning should convey the information to be processed in both textual and pictorial ways.

It is important that the texts in the textbook are written clearly and comprehensibly and that the professional terminology is explained. Reading, writing, and oral communication skills are necessary for students to understand the professional texts in the textbooks (Lemke, 1998; Martínez-Gracia et al., 2006). If they lack these skills, they will have problems understanding the professional texts. Peacock and Gates (2000) have shown that the structure of the text is not so important and does not contribute significantly to the quality of learning. Guidelines for the evaluation of textbook texts should therefore be: 1) the text must be stylistically appropriate (the writing style should be clear and close to everyday life); 2) the material should be didactically adapted to the needs of the target group of students (e.g., adapted to the average cognitive development of students at the respective educational level); 3) the material should contain elements that arouse the students' interest in learning a particular scientific content (e.g., life stories, case studies, problem-solving, adequate pictorial material etc.); 4) the material

should promote active learning; and (5) the material should include activities at various cognitive levels of knowledge (stepwise from knowledge to synthesis and evaluation) (Peacock & Gates, 2000; Devetak & Vogrinc, 2013).

An important part of the textbook is also the tasks in or at the end of each chapter, which allow students to consolidate and test their knowledge (Holcar, 2009) and give students personal insight into the knowledge acquired in the chapter.

A textbook without pictorial material is no longer conceivable today. Not only does the pictorial material make textbooks more attractive and dynamic, but it also breaks up the monotony of the text and contributes to the successful transfer of knowledge and, as Dimopoulos et al. (2003) report, to better understanding. The criteria for evaluating the pictorial material in the textbook include some important aspects such as: 1) it should be of high quality; 2) it should contain elements that stimulate students' interest; 3) it should promote the recall of what is already known and stored in students' long-term memory; 4) it should be specifically linked to the text; 5) it should be of different types; 6) the multidisciplinary aspect of the pictorial material should be emphasised; and 7) the pictorial material should complement the activities presented in the textbooks (Stylianidou et al., 2002; Cook, 2008; Devetak & Vogrinc, 2013).

In contrast, Stylianidou et al. (2002) reported that images can often cause additional problems for students in understanding the specific text in a textbook if they are not logically integrated into the text and their sole purpose is to fill the empty space and not to provide additional illustration to the text. However, a cognitive theory of multimedia learning (Mayer, 1997) suggests that the learner goes through three important cognitive processes: 1) selecting: verbal information yields a textbase and visual information yields a picture base; 2) organising, applied to the word base to create a verbally based model of the system being explained and is applied to the picture base to create a visually based model of the system being explained; and 3) integrating: occurs when the learner makes connections between corresponding events (or states or parts) in the verbally based model and the visually based model. These processes should be utilised by the learner when using the textbook. This theory states that it is better to present an explanation in words and pictures together than in words alone, and it extends Paivio's dual coding theory of learning mentioned earlier. Reid et al. (1983) suggest that visual-verbal learning allows students to reconcile the two modes and carefully compare the information available in the picture with the explanation in the text. In a study of six science textbooks, Mayer (1993) concluded that illustrations accounted for 55% of the printed space. Cook (2008) suggested that because a large proportion of science textbooks consist

of diverse visual material, more attention needs to be paid to understanding the impact of pictorial material on students learning.

For science textbooks, the pictorial material can be divided into two categories:(1) pictorial materials Type I (realistic, conventional, and hybrid images) and 2) pictorial materials Type II (images that comprise macroscopic, submicroscopic, and symbolic levels of representations of science concepts). Realistic images represent reality (e.g., photos or drawings). Conventional images are graphs, diagrams, maps, molecular structures, and similar, while hybrid images combine realistic and conventional images (Dimopoulos et al., 2003). Macroscopic images represent experimental phenomena or other natural phenomena at the sensory level, while submicroscopic images visualise the particulate level, such as atoms, ions, and molecules. Symbolic images present symbolic chemical language (e.g., symbols of elements, chemical formulas, chemical equations, mathematical equations, etc.) (Johnstone, 1982; Devetak et al., 2010).

In modern textbooks, the pictorial and textual material presented in textbooks could be upgraded in e-textbooks. The development from traditional textbooks to e-textbooks has opened new dimensions in the presentation of learning materials. The integration of various multimedia elements, such as videos, animations, and simulations of natural processes, not only enhances the visual and textual components but also contributes significantly to the overall value of the students' learning experience and promotes their digital literacy (Shalgimbekova et al., 2023).

Environmental contents in science textbooks and science curriculum

Environmental topics became increasingly important in the second half of the 20th century, mainly due to global environmental content (Bromley et al., 2011). Therefore, environmental education has started to be included in school curricula and textbooks.

In Slovenia, two major revisions of primary school curricula have been conducted in the previous three decades. The primary school curriculum was first adopted in 1998 (old curricula) by the Expert Council for General Education of the Republic of Slovenia in accordance with the curriculum guidelines prepared by the National Curriculum Council in 1996. In the period between 2007 and 2011, the second and last major curriculum renewal took place, which was completed in 2011 (current curricula). One of the focuses of this study is also to analyse the above-mentioned curriculum for science education in Grades 6 and 7 of primary school.

European Commission funding for post-pandemic recovery represented an opportunity for Slovenia to renew national curricula across the education chain. Slovenia, therefore, committed to renewing its education system and the national curriculum in primary and secondary schools in 2021 as part of the Recovery and Resilience Plan (RRP). The aim of the renewal of educational programs is to provide students and teachers with competences that are important for coping with current and future challenges (digital competences, competences for sustainable development, mechanisms for caring for (mental and physical) health and entrepreneurial competences) in order to strengthen the resilience of the education system. This began in 2022 with the adoption of the starting points for the renewal of the main program documents and is expected to continue until its completion in 2026 when new curricula will also be introduced into the education system for science and other subjects. For these reasons, the analysis of the two previous curricula is presented here from an environmental and sustainability perspective.

While students learn about forests, inland waters, oceans, and similar., they are also exposed to environmental content that focuses on the human impact on these ecosystems. The question, however, is how this content is taught and, more importantly, how much time and in what way environmental topics are integrated into the classroom as suggested in textbooks and curricula. As part of the RRP, the new science curriculum to be introduced in the 2026/27 school year will include sustainable development and green and resilient transition competences, among others.

The environmental content in the curriculum is often designed as cross-curricular activities, which means that teachers should incorporate it into a variety of subjects, curricular and extra-curricular activities, and science days. Environmental education should be integrated into the whole educational process, as this is the only way it can lead to the development of students' environmental competences and the formation of an environmentally aware citizen. Although the content that can stimulate the development of specific environmental skills in students can be found in textbooks and curricula, research (Lane & Wilke, 1994; Wade & Eland, 1995; Ernst, 2007, 2009; Rebolj & Devetak, 2012) shows that problems arise when teaching environmental content. One of them is the lack of knowledge about environmental content among teachers and the lack of time to prepare for teaching environmental content. Other obstacles include lack of training or opportunities for continuous professional development, lack of technical support, safety concerns, responsibility for teaching outside the classroom, lack of financial resources, lack of interest and support from local partners, and lack of support from parents (Rebolj & Devetak, 2012; Yurtsever & Angın, 2022).

Purpose of the study and research questions

Authors of the educational material should consider the criteria for quality material and, following them, prepare the textual and supporting pictorial elements appropriately. According to the above literature review, it can be assumed that only properly presented content in the textbook can help develop students' understanding of environmental concepts with fewer misconceptions. Devetak et al. (2010) conducted an analysis of Slovenian science and chemistry textbooks regarding selected chemistry concepts (Grades 1-9), but no attempt was made to analyse the textbooks from the perspective of environmental concepts in Grades 6 and 7. Therefore, this study focused on the most commonly used science textbooks in Slovenian primary schools for these grades and the curriculum for science in Grades 6 and 7.

The aim of this study is to examine how environmental concepts are presented to 11- and 12-year-old students in Slovenian science textbooks for Grades 6 and 7 of primary school from a textual and pictorial perspective. In addition, the aim was to examine how the science curriculum changes from the environmental competences perspective from the old to the current one. The textual material was analysed to determine what didactic elements are included in the textbooks and how environmental issues are presented in the textual part of the textbook. The analysis of the pictorial material was also included to gain insight into what type of pictorial material appears in the textbooks and what types of pictorial material are most frequently presented.

Particular attention was paid to the quality and clarity of the pictorial material and whether they were correctly placed on the page of the textbook so that they complemented the text and enabled students to better understand the material. In addition, to what extent is pictorial material in the different textbooks dealing with environmental content, and the consequences of reckless environmental behaviour were investigated.

According to the research problem, the following research questions were stated: 1) What are the differences between the learning objectives of the old and the current science curriculum in terms of environmental concepts and 2) What are the general and environmental characteristics of the textual and pictorial materials in the selected science textbooks in Grades 6 and 7 of primary school.

Method

The present study is based on a quantitative research approach; a descriptive, non-experimental educational research method was used. The criteria were developed on the basis of literature that presents criteria for the textbook analysis (Devetak & Vogrinc, 2013) and adapts them for Slovenian science textbooks/curricula. The criteria were used to analyse and compare the old and current 6th- and 7th-grade Slovenian science curricula for primary schools and to analyse and compare 6th- and 7th-grade science textbooks in Slovenian primary schools.

Sample

Four science textbooks for the 6th grade and four science textbooks for the 7th grade of primary school were analysed (Tables 1 and 2). Only textbooks available for students in the current school year (2023/24) and from a publisher that only issues textbooks for Grades 6 and 7 were analysed. In addition, the old curriculum (valid before the 2010/2011 school year) and the current curriculum (which replaced the old curriculum in the 2011/2012 school year and is still available for students in the current school year) for science in Grades 6 and 7 of primary school were analysed.

Table 1

The list of analysed sixth-grade science textbooks.

Textbook authors	Original textbook title (translated textbook title)	Publisher	Publication year	Abbreviation
Šorgo, A., Glažar, A. S., & Slavinec, M.	Aktivno v naravoslovje 1 (Active in the science 1)	DZS	2012	DZS/6
Bačič, T., Vilfan, M., Strgulc Krajšek, S., Dolenc Koce, J., & Krajšek, V.	Spoznavamo naravo 6 (We learn about the nature 6)	Narava d.o.o.	2012	NA/6
Torkar, G., Devetak, I., & Kovič, M.	Dotik narave 6 (Touch of Nature 6)	Rokus Klett	2012	R/6
Dermastia, M., Denac, D., Goričan, Š., Repnik, R., Urbančič, M. & Vidic, T.	Jaz pa vem, kako rožice cveto... (But I know how flowers bloom...)	Modrijan	2012	M/6

Table 2
The list of analysed seventh-grade science textbooks.

Textbook authors	Original textbook title (translated textbook title)	Publisher	Publication year	Abbreviation
Šorgo, A., Čeh, B., & Slavinec, M.	Aktivno v naravoslovje 2 (Active in the science 2)	DZS	2013	DZS/7
Bačič, T., Vilhar, B., Vilfan, M., Strgulc Krajšek, S., Fišer, C., Bevk, D., & Tkavc, R.	Spoznavamo naravo 7 (We learn about the nature 7)	Narava d.o.o.	2014	NA/7
Devatak, I., Rozman, L., Sopotnik, M., & Susman, K.	Dotik narave 7 (Touch of Nature 7)	Rokus Klett	2013	R/7
Tome, S., Ravnjak, B., Glažar, S. A. & Repnik, R.	Ste jo videli že, srno? (Have you seen her yet, doe?)	Modrijan	2016	M/7

Instrument

The documents (textbooks and national curriculum) were analysed using the rubric developed for the purposes of this study and by adapting some of the criteria developed for textbooks, pictorial and textual materials (Devetak et al., 2010; Devetak & Vogrinc, 2013).

The rubric for the general and textual analysis contains basic information about textbooks, such as the number of pages, the number of chapters, and the number of pages in each chapter. Regarding textual analysis, specific didactic elements of the textbook were examined, such as explanations, instructions for experiments, summaries, explanations of new concepts, the activities in the workbook, introductory motivation, and tasks between the text and at the end of each chapter. The rubric for the textbooks' pictorial analysis sections was divided into two parts: 1) pictorial material Type I and 2) pictorial material Type II. Type I includes realistic images (drawings) and conventional images (graphs, diagrams, sketches, schematics, maps, and other presentations). Type II includes macroscopic-level images (drawings or photographs depicting a phenomenon or process, e.g., an experiment), submicroscopic images, and symbolic images. All the pictorial and textual material was also analysed in terms of environmental content, taking into account the framework of topics included in the national curriculum.

Research design

According to the rubrics developed for the general, textual, and pictorial elements in the textbooks, which follow the framework of the environmental content presented in the national science curriculum, the coding process was carried out by two independent persons. To ensure high reliability of the categorisation, two researchers (the two authors of this article) independently evaluated the textbooks using the coding table, resulting in an overall reliability of 96%. Both evaluations were then compared at the points where differences occurred, and after consideration, the more appropriate evaluation was chosen.

Results

The first part of the results shows the comparison between the old and the current national science curriculum in terms of environmental concepts, followed by general data for a comparison between textbooks (Tables 3 and 4). The second part of the results presents the analysis of the textbooks in terms of environmental content.

Environmental contents in the science curriculum (old and current)

The old science curriculum for the 6th and 7th grades of primary school was valid until 2011 when the then-responsible ministry (Ministry of Education and Sports) renewed the science curriculum. The number of lessons (one lesson is 45 minutes) for science in each grade remained the same, so students attended 70 lessons of science in Grade 6 and 105 lessons of science in Grade 7 throughout the school year: a total of 175 lessons of science in two school years. The old and current curricula differ in the scope of content (see Table 3). The old curriculum included a definition of the subject describing its place in primary education, the philosophy and nature of the subject, and the general and operational objectives presented. It also included activities, content, concepts and cross-curricular links, specific didactical recommendations, and the general proposals for knowledge assessment (i.e., a knowledge catalogue indicating the basic and minimum knowledge standards). The current curriculum also contains a definition of the subject, the general objectives, the operational objectives, and the content describing the science procedures and skills, as well as the thematic sets. It includes a section on the knowledge standards, which also describes the science procedures and skills and the thematic sets and makes

some assessment suggestions for teachers. At the very end of the curriculum is the *Didactic Recommendations* section, which suggests teaching methods and approaches, guidelines for planning and implementing student activities, individualisation and differentiation, aspects, and cross-curricular links for each specific topic.

The old 6th-grade science curriculum is much more clearly organised and defines the topics of the subject more precisely than the current one, which only covers more general topics and allows teachers to choose more specific contextual approaches to teach the concepts (e.g., environmental topics).

Nevertheless, the presentation of environmental content in both curricula is rather scarce or non-existent. In the sixth grade, students learn how they can contribute to the protection of the environment through appropriate behaviour, become aware of the significant influence of each individual on the environment, learn that the mining and processing of energy and other natural resources affect the environment, learn about the importance of efficient energy use, learn about the problems of scarcity and overuse of natural resources, water, raw materials and fuels, and become aware of the need to use these resources sparingly. In the seventh grade, students learn about the effects and consequences of fertilisation and the use of pesticides in agriculture on the pollution of groundwater, learn that the concentration of pollutants in water, air and soil can increase due to natural causes and human activities, which has a negative impact on organisms, learn about the main causes of pollution of water, groundwater, air and soil, learn about the main pollutants and the consequences of their effects on organisms and the environment, as well as the possibilities and measures to reduce and prevent pollution. They also learn about the effects of different types of transportation and communication on the environment and the causes of the increase in emissions and the associated global warming, which is reflected in climate change and terrestrial and aquatic ecosystems.

In the old science curriculum for 6th grade, there are no learning objectives that relate directly to environmental content. Some teaching and learning suggestions for teachers that relate to environmental content can be found in the chapter *Didactic Recommendations*. The current curriculum contains the chapter Human Impact on the Environment with eight learning objectives directly related to environmental content. This corresponds to 8.6% of all learning objectives in the 6th grade (Table 3).

Table 3

Comparison between the old and current 6th-grade science curriculum in terms of topics and learning objectives related to environmental content and objectives for the topics defined by the national science curriculum.

	The content section or learning topic	Environmental/ all objectives
Old curriculum	Living and non-living nature	0/7
	Substances	0/12
	Garden	0/18
	Hedges, lawns, and parks (optional educational topic)	0/10
	Greenhouse (optional educational topic)	0/10
	Field	0/19
	Orchard (optional educational topic)	0/15
	Vineyard (optional educational topic)	0/10
	Meadow	0/7
	Flow and energy	0/22
	Colours	0/18
Percentage of learning objectives associated with environmental content		0/148 (0%)
Current curriculum	Substances	0/14
	Energy	0/11
	Living nature	0/60
	Human impact on the environment	8/8
Percentage of learning objectives associated with environmental content		8/93 (8.6%)

The old 7th-grade science curriculum is much more precisely defined in terms of specific topics than the current one (Table 4). In contrast to the 6th-grade science curriculum, both the old and the current 7th-grade curriculum contain learning objectives that are directly related to environmental content. In the old curriculum, there are four (3.7%) learning objectives in different subject areas, while in the current curriculum, eleven learning objectives appear in the *Human Impact on the Environment* section, which accounts for 11% of all learning objectives in the 7th grade. In the old curriculum, there was also a section on didactic recommendations in which some environmentally relevant content could be found but which must be included by the teachers in the relevant topics.

Table 4

Comparison between the old and current 7th-grade science curricula in terms of content sections/learning topics and learning objectives related to environmental content and all objectives for the topics defined in the national science curriculum.

	The content section or learning topic	Environmental/ all objectives
Old curriculum	Substances, their properties, and changes	0/4
	Pure substances and mixtures	0/4
	Air	1/5
	Forest	0/26
	Sound	0/8
	Light	0/15
	Wave motion	0/7
	Water	1/4
	Inland waters	1/22
	Sea	1/13
Percentage of learning objectives associated with environmental content		4/108 (3.7%)
Current curriculum	Substances	0/21
	Energy	0/21
	Live nature	0/47
	Human impact on the environment	11/11
Percentage of learning objectives associated with environmental content		11/100 (11%)

Environmental content of textbooks

The structure of the 6th-grade textbooks published by different publishers varies considerably (Table 5). On average, the textbooks have 116 pages. The textbooks also have a different number of chapters. The textbook DZS/6 has the most chapters (9) and a maximum number of pages. The M/6 textbook has the fewest chapters (4 chapters), but the chapters are the longest on average (23 pages per chapter on average), and they present a broader range of concepts covering a given topic. The textbooks contain chapters with very different headings. The textbooks also differ in the number of pages per chapter. On average, the textbook NA/6 has the fewest pages per chapter (15 pages).

Table 5

Number of pages, number of chapters and chapter headings in analysed 6th-grade textbooks.

Textbook	The number of pages	The number of chapters	Chapter heading/the number of pages
DZS/6	144	9	1. Substances/16; 2. Rocks and mould/18;3. Energy/24; 4. Cell and organism/12; 5. Structure and function of a plant/24; 6. Growth, development, and reproduction of plants/14; 7. Plant sorting/10; 8. Plants and environment/18; 9. Man and environment/11
NA/6	116	8	1. Everything is built from substances, living and non-living nature/10; 2. Stream and energy /10; 3. Living creatures are composed of cells /10; 4. Different parts of the body perform a variety of tasks /20; 5. Organisms reproduction /12; 6. Organisms have names/12; 7. Organisms were clamped into the environment /22; 8. Man exploits nature /13
R/6	109	5	1. Since the formation rock to plant life /26; 2. From sun to the food/14; 3. Everything is made from substances/22; 4. From life of plants/20; 5. Ecosystems and Environmental Protection /19
M/6	91	4	1. Autumn/22; 2. Winter/26; 3. Spring/24; 4. Summer/19

Textbooks for 7th grade have an average of 169 pages. The textbooks also differ in the number of chapters, the headings, and the number of pages in each chapter. The textbook DZS/7 has the highest number of chapters (11 chapters). Other textbooks, R/7 and M/7 with 4 and NA/7 with 5 chapters, present science concepts very broadly in their chapters with more general headings. The chapters also differ in terms of the number of pages. The textbook NA/7 has the highest average number of pages per chapter (43 pages per chapter), followed by the textbook M/7 (36 pages per chapter) and the textbook R/7 (35 pages per chapter). The textbook with the lowest average number of pages per chapter is DZS/7 (16 pages per chapter).

Table 6

Number of pages, number of chapters and chapter headings in analysed 7th-grade textbooks.

Textbook	The number of pages	The number of chapters	Chapter heading/the number of pages
DZS/7	176	11	1. Substances/34; 2. Light in colours/18; 3. Sound and waves /16; 4. Viruses, bacteria and fungi /16; 5. Animals, construction types and classification of animals /16; 6. Digestion, respiration, excretion and transfer of substances in the body /12; 7. Support, protection and movement /12; 8. Control and Detection /10; 9. Reproduction, growth and development of animals /12; 10. Structure and function of ecosystems /14; 11. Human and environment/13
R/7	141	4	1. The diversity of nature /38; 2. Organisms related to the environment /32; 3. What is happening in organisms? /36; 4. Human impacts on nature /27
NA/7	215	5	1. Substances/26; 2. Waves/42; 3. Animals/62; 4. Structure and function of animal protozoans, fungi and bacteria /20; 5. Structure and function of ecosystems /58
M/7	142	4	1. Autumn/48; 2. Winter/46; 3. Spring/30; 4. Summer/11

Regarding the pictorial material in the 6th-grade textbooks, textbook M/6 contains the fewest pictorial material of Type I and Type II (377 images), while most pictorial material of Type I and Type II can be found in textbook R/6 (450) (Table 7). Most pictorial material comprises realistic images, followed by conventional images, macroscopic images, and sub-microscopic images of science phenomena. There are no symbolic images in any of the 6th-grade textbooks examined. The textbook M/6 contains the highest percentage of realistic images related to environmental content (2.4%), followed by textbooks DZS/6 (2.3%) and NA/6 (1.2%). The lowest proportion of realistic images associated with environmental content is found in the textbook R/6 (0.6%). Conventional images associated with environmental content are only found in the textbook DZS/6 (1.5%). None of the 6th-grade textbooks analysed contain macroscopic images and sub-microscopic images associated with environmental content. Of all the 6th-grade textbooks analysed, the textbook DZS/6 has the highest percentage of pictorial material Type I and Type II related to environmental content (2.0%), while the lowest percentage of pictorial material Type I and Type II in connection with environmental content is in the textbook R/6 (0.4%).

Table 7
Analysis of pictorial material type I and type II in sixth-grade textbooks.

Publisher	Pictorial material type I		Pictorial material type II			TP
	RI	CI	MI	SuI	SyI	
DZS/6	6/257 (2.3%)	2/130 (1.5%)	0/13	0/8	0/0	8/408 (2.0%)
NA/6	4/331 (1.2%)	0/50	0/3	0/3	0/0	4/387 (1.0%)
R/6	2/348 (0.6%)	0/86	0/9	0/7	0/0	2/450 (0.4%)
M/6	7/297 (2.4%)	0/69	0/7	0/4	0/0	7/377 (1.8%)

RI Number of realistic images (photograph) associated with environmental content / Number of all realistic images (%).
CI Number of conventional images (graph, diagram, drawing, diagram, model of a molecule) associated with environmental content / Number of all conventional images (%).
MI Number of macroscopic images (photograph of an experiment or phenomenon) associated with environmental content / Number of all macroscopic images (%).
SuI Number of sub-microscopic images associated with environmental content / Number of all sub-microscopic images (%).
SyI Number of symbolic images associated with environmental content / Number of all symbolic images (%).
TP Number of pictorial material Type I and Type II associated with environmental content/ Total pictorial material Type I and Type II (%)

Although the textbooks for the 7th grade contain a large amount of pictorial material, they differ significantly in the amount of pictorial material of Type I and Type II. As expected, realistic images make up the majority of the pictorial material in all the textbooks analysed, followed by conventional images, macroscopic images, and sub-microscopic images of science phenomena (Table 8). Symbolic images are only present in textbooks DZS/7, NA/7 and R/6. The images are of high quality and complement the textual material in the textbooks. The textbook NA/7 contains the most images (532 images), followed by M/7 (523 images) and R/7 (357 images), while the fewest images can be found in the textbook DZS/7 (350 images). Textbook R/7 contains the most realistic images associated with environmental content (2.5%), while the lowest number of realistic images associated with environmental content is found in textbook DZS/7 (0.4%). Only the textbooks DZS/7 and R/7 contain conventional images related to environmental content. None of the textbooks examined for 7th grade contain macroscopic images, sub-microscopic images, or symbolic images related to environmental content. Of all the 7th-grade textbooks analysed, R/7 has the highest percentage of pictorial material of Types I and II related to environmental content (2.0%), while the two textbooks, DZS/7 and M/7 have the lowest percentage of pictorial material of Types I and II related to environmental content (0.6%).

Table 8

Analysis of Type I and Type II pictorial material in 7th-grade textbooks.

Publisher	Pictorial material type I		Pictorial material type II			TP
	RI	CI	MI	SuI	SyI	
DZS/7	1/230 (0.4%)	1/62 (1.6%)	0/31	0/26	0/1	2/350 (0.6%)
NA/7	8/362 (2.2%)	0/119	0/27	0/22	0/2	8/532 (1.5%)
R/7	6/236 (2.5%)	1/80 (1.3%)	0/31	0/9	0/1	7/357 (2.0%)
M/7	3/377 (0.8%)	0/108	0/18	0/20	0/0	3/523 (0.6%)

RI Number of realistic images (photograph) associated with environmental content / Number of all realistic images (%).
CI Number of conventional images (graph, diagram, drawing, diagram, model of a molecule) associated with environmental content / Number of all conventional images (%).
MI Number of macroscopic images (photograph of an experiment or phenomenon) associated with environmental content / Number of all macroscopic images (%).
SuI Number of sub-microscopic images associated with environmental content / Number of all sub-microscopic images (%).
SyI Number of symbolic images associated with environmental content / Number of all symbolic images (%).
TP Number of pictorial material of Type I and Type II associated with environmental content/ Total pictorial material type I and type II (%)

Table 9 shows the results of the analysis of the textual material, such as explanations, instructions for experiments, interesting facts, summaries, explanations of new concepts, activities in the notebook, motivational content, didactic components, and tasks which are directly related to environmental content in each of the 6th-grade textbooks studied.

The most textual material related to environmental content is found in textbook M/6 (9.4% of the total textual material), followed by textbook DZS/6 (5.4%) and NA/6 (4.3%). The lowest percentage of textual material relating to environmental content is included in textbook R/6 (2.7%). Summaries of the most important concepts can be found at the end of the chapters in all textbooks.

Tasks relating to the environmental content can only be found in the textbooks DZS/6, R/6, and M/6; the textbook R/6 contains the highest proportion of tasks relating to the environmental content (21.7%), followed by M/6 (16%) and DZS/6 (2%). Tasks for the students can be found at the end of the respective chapter (DZS/6, R/6, and M/6) and in the text (DZS/6, R/6, and M/6).

The textbook R/6 also contains a checkbox for the integration of the students' knowledge, which is designed like an interdisciplinary textbook. The *Activities in the notebook*, in which students are encouraged to continue the learning process in the corresponding notebook, are not included in the textbooks studied. Additional interpretations of new concepts are presented in the

Table 9

Analysis of textual material and tasks in sixth-grade textbooks.

Publisher	Textual material								Tasks		
	Tm1	Tm2	Tm3	Tm4	Tm5	Tm6	Tm7	Tmsum	T1	T2	Tsum
DZS/6	20/285 (7%)	0/49	3/54 (5.6%)	1/36 (2.8%)	0/9	0	0/9	24/442 (5.4%)	0/125 (0%)	4/76 (5.2%)	4/201 (2%)
NA/6	3/81 (3.7%)	0/5	3/67 (4.5%)	1/8 (12.5%)	0	0	0	7/161 (4.3%)	0	0	0
R/6	2/287 (0.7%)	5/36 (13.9%)	0/5	2/32 (6.2%)	0/12	0	2/25 (8%)	11/397 (2.7%)	7/32 (21.9%)	1/5 (20%)	8/37 (21.7%)
M/6	1/19 (5.3%)	5/44 (11.4%)	2/31 (6.4%)	2/17 (11.8%)	0	0	2/17 (12%)	12/128 (9.4%)	7/47 (14.9%)	1/3 (33.3%)	8/50 (16%)

Table 10

Analysis of textual material and tasks in seventh-grade textbooks.

Publisher	Textual material								Tasks		
	Tm1	Tm2	Tm3	Tm4	Tm5	Tm6	Tm7	Tmsum	T1	T2	Tsum
DZS/7	16/284 (5.6%)	0/20	2/41 (4.9%)	3/37 (8.1%)	1/11 (9.1%)	0	0/39	24/443 (5.4%)	4/115 (3.5%)	2/57 (3.5%)	6/172 (3.5%)
NA/7	6/97 (6.2%)	0/25	6/133 (4.5%)	1/21 (4.8%)	0	0	0/5	13/281 (4.6%)	0	1/21 (4.8%)	1/21 (4.8%)
R/7	18/323 (5.2%)	2/60 (3.3%)	1/7 (14.3%)	4/46 (8.7%)	1/18 (5.5%)	0	2/42 (4.8%)	28/496 (5.6%)	5/46 (10.9%)	1/4 (25%)	6/50 (12%)
M/7	2/14 (14.3%)	2/34 (5.9%)	3/46 (6.5%)	1/22 (4.5%)	0	0	1/22 (4.5%)	9/138 (6.5%)	2/41 (4.9%)	0/7	2/48 (4.2%)

Tm1 Number of explanations related to environmental content/number of all explanations.
Tm2 Number of instructions for experiments related to environmental content/number of all instructions for experiments.
Tm3 Number of interesting facts related to environmental content/number of all interesting facts.
Tm4 The number of summaries related to environmental content/number of all summaries.
Tm5 The number of explanations of new concepts related to environmental content/number of all explanations of new concepts.
Tm6 Number of activities in the notebook related to environmental content/number of all activities in the notebook.
Tm7 Number of motivating content related to environmental content/number of all motivating content.
Tmsum The total number of didactic components related to environmental content.
T1 The number of tasks in the text that are linked to environmental content/number of all tasks in the text.
T2 The number of tasks at the end of the chapters that are linked to environmental content/number of all tasks at the end of the chapters.
Tsum The total number of tasks associated with environmental content / the total number of tasks.

textbooks DZS/6 and R/6. All textbooks, with the exception of the textbook NA/6, contain an introductory text to arouse the students' interest. Other textbooks contain further specific sections, such as: in NA/6 the chapter *Do it yourself*, in DZS/6 a part entitled *Some instructions on first aid in case of injuries* and *Optional knowledge*, and in R/6 the chapters *For the curious*, *Connect the knowledge* and *Key ideas and knowledge*.

In addition to the textual and pictorial elements of the textbook, all of the 6th-grade textbooks examined contain a section entitled *Instructions for Experimental Work and Explanations and Interesting Facts*.

Table 10 shows the analysis of the textual material in relation to environmental content in each 7th-grade textbook. The textbooks analysed differ in terms of textual material and tasks related to environmental content.

The highest percentage of textual material related to environmental content was found in textbook M/7 (6.5%) and the lowest in textbook NA/7 (4.6%). Textbook M/7 contains the most explanations of environmental content (14.3%), and textbook R/7 contains the least (5.2%). The textbook R/7 contains the highest percentage of interesting facts (14.3%) and summaries (8.7%) related to environmental content.

Tasks relating to the environmental content can be found in all of the 7th-grade textbooks examined. The textbook R/7 contains the highest proportion of tasks on environmental content (12%, most tasks are found between the text and at the end of each chapter), followed by NA/7 (4.8%), M/7 (4.2%) and DZS/7 (3.5%).

Environmental content is present in all textbooks analysed, but judging by the results of the analysis, this topic is insufficiently presented. All textbooks analysed contain explanations of new concepts, instructions for experiments, interesting facts, summaries, and introductory motivation at the beginning of each chapter. None of the textbooks contain the *Activities in the notebook* section. The textbooks DZS/7, R/7 and M/7 also contain tasks for students between the text and tasks at the end of each chapter. The textbook R/7 contains sections such as *Health tips*, *For the curious*, *You can also read,* and *Protecting nature*.

Discussion

This study aimed to determine what learning objectives relating to environmental content are included in the old and current science curriculum for Grades 6 and 7 and whether the science textbooks for those grades offer students opportunities to develop sustainable development competencies in relation to environmental content.

The old Grade 6 curriculum does not contain any learning objectives that relate directly to environmental content, while the old Grade 7 curriculum contains some of the learning objectives that relate to environmental content. In the science curriculum for Grades 6 and 7, there is a chapter on the impact of humans on the environment. The mentioned chapter contains eight learning objectives related to environmental content. These eight learning objectives account for only 8.6% of the learning objectives directly related to environmental content, compared to all 93 learning objectives in the Grade 6 curriculum. It can be seen that the curriculum has changed to such an extent that the current curriculum contains learning objectives that are directly linked to the development of students' environmental knowledge, whereas there were no such objectives in the old curriculum.

In the current Grade 7 curriculum, eleven learning objectives are listed in the chapter on human impact on the environment. At the level of all learning objectives in the current Grade 7 science curriculum, these eleven learning objectives account for 11% of all (100) learning objectives of that grade. Although there are not many learning objectives related to environmental content in the current curriculum, it can be concluded that the reform of the curriculum in 2011 has favoured environmental content and that appropriate implementation in the school setting promotes the development of environmental competences to some extent.

In summary, it is important to mention that in the renewed science curriculum in both grades, which will be the result of the current curriculum reform (see above), a significant increase in learning objectives for sustainable development should be integrated into different topics of the curriculum in order to fulfil the criterion that any curriculum should develop students' competences to actively participate in sustainable development activities as adult critical citizens. This is also important because, according to our findings, the current textbooks available to students lack direct implementation of science-oriented sustainable development goals such as natural resource management, climate change, water-related issues, marine issues, biodiversity and ecosystems, circular economy, environmentally sound management of chemicals and waste, and many other topics. For this reason, it is recommended that the

renewed curriculum be introduced in the 2026/27 school year, and the corresponding textbooks should more clearly include the implementation of the science-oriented sustainable development goals that are currently missing.

In line with our findings, some other studies (Lane & Wilke, 1994; Ernst, 2007, 2009; Fraser et al., 2015; Ashmann & Franzen, 2017) reported that although it is possible to find content in the curriculum that could promote the development of specific environmental competences among students, and they also emphasised that there are problems among teachers to teach environmental content. Other barriers include lack of training or opportunities for ongoing professional development, lack of technical support, safety concerns, teachers' responsibility for learning outside the classroom, lack of resources, lack of interest and support from local partners, and lack of support from parents (Rebolj & Devetak, 2012).

After analysing selected science textbooks for Grades 6 and 7, it can be concluded that the textbooks differ in terms of the number of pages and chapters, the number of pages per chapter, the chapter headings (although they deal with similar topics) and the amount of pictorial material that relates directly to the environmental content. Realistic images predominate in all textbooks, followed by conventional images and macroscopic images. Moreover, all textbooks include images because visualisation plays a very important role in the comprehension of science content (Bunce & Gabel, 2002; Dimopoulos et al., 2003), and these images are appropriate with regard to the cognitive development of the students and the type of content presented. Images that are presented vividly and placed in the right context can have a major impact on the development of environmental competences in both children and adults, as they highlight the state of the environment and, ultimately, the consequences of pollution. Therefore, it makes sense that the number of visuals in textbooks showing environmental problems and impacts should increase, as this should have a positive impact on a more positive attitude towards the environment (Ahmad et al., 2015; Chen, 2017). Although all the textbooks studied contain pictorial material directly related to environmental content, according to Paivio's theory (1991), there are not enough images to promote the development of environmental values in students through visual channels.

The textbooks studied also differ in terms of the textual material that presents environmental content. Our findings show that the amount of textual material in textbooks is increasing in favour of environmental content. This suggests that there is some environmental content in 6th- and 7th-grade science textbooks that are consistent with the learning goals of the curriculum but that some sustainability content is still missing (e.g., local and global content on

protecting, restoring and promoting the sustainable use of terrestrial ecosystems, sustainable management of forests, halting and reversing land degradation and halting biodiversity loss, reducing death and diseases from hazardous chemicals, and air, water and soil pollution, strengthening resilience and capacity to adapt to climate-related risks and natural disasters, energy consumption, waste generation, public health threats, poverty, social exclusion, natural resource management, biodiversity loss and land use, etc.) and should be part of the new textbooks developed by publishers in the future. For this reason, the curriculum reform currently underway in Slovenia should thoroughly consider the integration of science-oriented sustainable development into the science curriculum in Grades 6 and 7 of primary school.

Overall, it has been proven that science is not one of the most popular school subjects among students (Grubelnik, 2011), but at the same time, the data show that fewer and fewer students are choosing to study science (Šorgo et al., 2018). Nevertheless, the data from TIMSS and PISA show that Slovenian students achieve better results on average in science knowledge tests than students in other participating countries (Japelj Pavešić et al., 2012; Štraus et al., 2007) and this could also be reflected by the use of quality textbooks in schools.

Conclusion

The results of the analysis of science Grade 6 and 7 curricula and textbooks give us an insight into the state of environmental education in Slovenia. From the results, guidelines for better and stronger integration of environmental content in textbooks and curricula could be derived for the renewal of curriculum in the framework of the Recovery and Resilience Plan.

The results of this study can influence teachers' decisions when choosing a textbook, as they can draw attention to important didactic components of textbooks, for example, the textbook by DZS, which contains various didactic elements that define a quality textbook according to selected criteria. At the same time, the survey revealed some inconsistencies in the textbooks that teachers should be aware of in order to supplement their lessons with additional teaching material to achieve the learning objectives. These findings can also help textbook authors, editors, and publishers as they can significantly improve the didactic value of existing textbooks in future editions. It is also important that authors and publishers include appropriate pictorial and textual elements in future textbooks that will be developed after the introduction of the new curriculum in Slovenian schools at the beginning of the 2026/27 school year in order to improve the development of students' environmental competences.

Considering the analysis presented in this paper, the limitation of this study is the lack of an in-depth content analysis of the environmental textual and pictorial elements of the specific textbooks. This should be done in the future textbooks that will be published after the renewal of the science curriculum in 2026. It is important to emphasise that an examination of curricula and related textbooks is possible, focusing on subjects such as home economics, biology, chemistry, physics, and geography. Such an analysis could provide a more comprehensive overview of the environmental competencies promoted at the lower secondary level. It is also recommended to investigate how Slovenian teachers and students use textbooks in science classrooms and how much knowledge they gain by using textbooks in the future, regardless of whether they are classic or digital books, such as e-textbooks, as the development of digital competences is as important as that of sustainability, according to the recommendations of the EU commission (Ferrari & Punie, 2013).

References

Agbedahin, A. V. (2019). Sustainable development, Education for Sustainable Development, and the 2030 Agenda for Sustainable Development: Emergence, efficacy, eminence, and future. *Sustainable Development*, *27*(4), 669–680.

Ahmad, J., Sritharan, G., & Nasir, N. N. (2015). The effectiveness of video and pamphlets in influencing youth on environmental education. *Jurnal Komunikasi: Malaysian Journal of Communication*, *31*(1), 281–296.

Ashmann, S., & Franzen, R. L. (2017). In what ways are teacher candidates being prepared to teach about the environment? A case study from Wisconsin. *Environmental Education Research, 23*(3), 299–323. https://doi.org/10.1080/13504622.2015.1101750

Bačič, T., Vilfan, M., Strgulc Krajšek, S., Dolenc Koce, J., & Krajšek, V. (2012). *Spoznavamo naravo 6. Učbenik za naravoslovje v 6. razredu osnovne šole [We learn about the nature 7, Science textbook for 7th grade of primary school].* Narava d.o.o.

Bačič, T., Vilhar, B., Vilfan, M., Strgulc Krajšek, S., Fišer, C., Bevk, D., & Tkavc, R. (2014). *Spoznavamo naravo 7. Učbenik za naravoslovje v 7. razredu osnovne šole [We learn about the nature 7, Science textbook for 7th grade of primary school].* Narava d.o.o.

Bianchi, G., Pisiotis, U., & Cabrera, M. (2022). *GreenComp, the European sustainability competence framework, European Commission*. https://doi.org/10.2760/13286

Bromley, P., Meyer, J. W., & Ramirez, F. O. (2011). The worldwide spread of environmental discourse in history, civics, and social studies textbooks. *Comparative Education Review*, *55*(4), 517–545.

Bunce, D. M., & Gabel, D. (2002). Differential Effect in the achievement of males and females of teaching the particulate nature of chemistry. Journal of Research in Science Teaching, 39(10), 911–972. https://doi.org/10.1002/tea.10056

Chen, X. (2017). A comparative study of visual representations in conventional, digitized and interactive high school science textbooks. Journal of Visual Literacy, 36(2), 104–122.

Cook, M. (2008). Students' comprehension of science concepts depicted in textbook illustrations. Electronic Journal of Science Education, 12(1), 1–14.

Dermastia, M., Denac, D., Goričan, Š., Repnik, R., Urbančič, M., & Vidic, T. (2017). *Jaz pa vem, kako rožice cveto. Naravoslovje za 6. razred osnovne šole [But I know how flowers bloom… Science for 6th grade of primary school]*. Modrijan.

Devetak, I., Rozman, L., Sopotnik, M., & Susman, K. (2013). *Dotik narave 7. Učbenik za naravoslovje v 7. razredu osnovne šole [Touch of Nature 7. Science textbook for 7th grade of primary school]*. Rokus Klett.

Devetak, I., Vogrinc, J., & Glažar, S. A. (2010). States of matter explanations in Slovenian textbooks for students aged 6 to 14. International Journal of Environmental and Science Education, 5(2), 217–235.

Devetak, I., & Vogrinc, J. (2013). The criteria for evaluating the quality of the science textbooks. In M. S. Khine (Ed.), *Critical Analysis of Science Textbooks* (pp. 3–15). Springer. https://doi.org/10.1007/978-94-007-4168-3_1

Dunn, P. K., Brunton, E. A., & Farrar, M. B. (2022). **Your online textbook is ready: a shareable, interactive** online textbook in response to COVID-19 lockdowns. *International Journal of Mathematical Education in Science and Technology*, *53*(3), 582–593.

Dimopoulos, K., Koulaidis, V., & Sklaveniti, S. (2003). Towards an analysis of visual images in school science textbooks and press articles about science and technology. Research in Science Education, 33(2), 189–216. https://doi.org/10.1023/A:1025006310503

Eilks, I. (2015). Science education and education for sustainable development-justifications, models, practices and perspectives. *Eurasia Journal of Mathematics, Science & Technology Education*, *11*(1), 149–158

Erjavšek, M., Lovšin Kozina, F., & Kostanjevec, S. (2021). In-service home economics teachers' attitudes to the integration of sustainable topics in the home economics subject. *Center for Educational Policy Studies Journal*, *11*(1), 27–47. https://doi.org/10.26529/cepsj.614

Ernst, J. (2007). Factors associated with K–12 teachers' use of environment-based education. *The Journal of Environmental Education, 38*(3), 15–32. https://doi.org/10.3200/JOEE.38.3.15-32

Ernst, J. (2009). Influences on US middle school teachers' use of environment-base Education. *Environmental Education Research, 15*(1), 71–92. https://doi.org/10.1080/13504620802710599

Ferrari, A., & Punie, Y. (2013). DIGCOMP: A framework for developing and understanding digital competence in Europe. http://digcomp.org.pl/wp-content/uploads/2016/07/DIGCOMP-1.0-2013.pdf

Fraser, J., Gupta, R., & Krasny, M. E. (2015). **Practitioners' perspectives on the purpose of environ**mental education. *Environmental Education Research, 21*(5), 777–800. https://doi.org/10.1080/13504622.2014.933777

Freire, S., Baptista, M., & Freire, A. (2016). Sustainability and science learning: perceptions from 8th grade students involved with a role playing activity. *Universal Journal of Educational Research, 4*(8), 1757–1763.

Gkitzia, V., Salta K., & Tzougraki C. (2011). Development and application of suitable criteria for the evaluation of chemical representations in school textbooks. *Chemistry Education Research and Practice, 12*, 5–14.

Glavič, P. (2006). *Pripombe prof. dr. Petra Glaviča na Nacionalni progam visokega šolstva 2006–2010 [Comments by Prof. Dr. Petr Glavič on the National Higher Education Program 2006-2010]*. http://abra.fkkt.uni-lj.si/fno1leban/resolucija/7.doc

Grubelnik, V. (2011). *Razvoj naravoslovnih kompetenc [Development of science competences]*. http://kompetence.uni-mb.si/

Holcar, A. (2009). Ocenjevanje za učenje [Assessment for learning]. In M. Turk-Škraba (Ed.), Didaktika ocenjevanja znanja. Vodenje procesa ocenjevanja za spodbujanje razvoja učenja (pp. 116–121). Zavod RS za šolstvo.

Japelj Pavešić, B., Svetlik, K., & Kozina, A. (2012). *Znanje matematike in naravoslovja med osnovnošolci v Sloveniji in po svetu, izlsedki raziskave TIMSS 2011 [Knowledge of mathematics and science among primary school students in Slovenia and worldwide, results of the 2011 TIMSS survey]*. Pedagoški inštitut. https://www.pei.si/wp-content/uploads/2018/12/porocilo_timss11_celo.pdf

Jimenez, J. D., Lerch, J., & Bromley, P. (2017). Education for global citizenship and sustainable development in social science textbooks. European Journal of Education, 52(4), 460–476.

Johnstone, A. H. (1982). Macro- and Micro-chemistry. *School Science Review, 64*, 377–379.

Johnston, N., & Salaz, A. M. (2019). Exploring the reasons why university students prefer print over digital texts: An Australian perspective. *Journal of the Australian Library and Information Association*, *68*(2), 126–145.

Kalin, J. (2004). Vloga medijev pri sodobnem pouku in presojanje njihove učinkovitosti [The role of media in modern lessons and the judgment of their efficiency]. In M. Blažič (Ed.), *Media in Education* (pp. 210–215). Higher Education Centre.

King, C. J. H. (2010). An analysis of misconception in science textbooks: Earth science in England and Wales. *International Journal of Science Education, 32*(5), 565–601. https://doi.org/10.1080/09500690902721681

Kopnina, H. (2020). Education for the future? Critical evaluation of education for sustainable development goals. *The Journal of Environmental Education*, *51*(4), 280–291.

Laçin Şimşek, C. (2011). Investigation of environmental topics in the science and technology curriculum and textbooks in terms of environmental ethics and aesthetics. Educational Sciences: Theory and Practice, 11(4), 2252–2257.

Lane, J., & Wilke, R. (1994). Environmental education in Wisconsin: A teacher survey. *The Journal of Environmental Education*, *24*(4), 9–14. https://doi.org/10.1080/00958964.1994.9941959

Lau, K. H., Lam, T., Kam, B. H., Nkhoma, M., Richardson, 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

Lemke, J. L. (1998). Multiplying meaning: Visual and verbal semiotics in scientific text. In J. R. Martin & R. Veel (Eds.), Reading Science: Critical and Functional Perspectives on Discourses of Science

(pp. 87–113). Routledge.

Martínez-Gracia, M. V., Gil-Quilez, M. J., & Osada, J. (2006). Analysis of molecular genetics content in Spanish secondary textbooks. Journal of Biological Education, 40(2), 35–60. https://doi.org/10.1080/00219266.2006.9656014

Martin, O. M., Mullis, V. I., Foy, P., & Stanco, M. G. (2011). *TIMSS 2011 international results in science*. International Association for the Evaluation of Educational Achievement, The Netherlands.

Mayer, R. E. (1993). Illustrations that instruct. In R. Glaser (Ed.), *Advances in instructional psychology* (pp. 253–284). Erlbaum.

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychologist, 32*(1), 1–19. https://doi.org/10.1207/s15326985ep3201_1

Mulvik, I., Pribuišis, K., Siarova, H., Vežikauskaite, J., Sabaliauskas, E., Tasiopoulou, E., Gras-Velazquez, A., Bajorinaite, M., Billon, N., Fronza, V., Disterheft, A., & Finlayson, A. (2021). Education for environmental sustainability: policies and approaches in European Union Member States. Final Report. European Commission. https://op.europa.eu/en/publication-detail/-/publication/a193e445-71c6-11ec-9136-01aa75ed71a1

Peacock, A., & Gates, S. (2000). Newly qualified primary teachers' perceptions of the role of text material in teaching science. Research in Science & Technological Education, 18(2), 155–171. https://doi.org/10.1080/713694982

Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology, 45*(3), 255–287.

Quinn, F., Elliott, S., Taylor, N., & Littledyke, M. (2015). Education for sustainability in primary science education. In N. Taylor, F. Quinn, & C. Eames (Eds.), *Educating for Sustainability in Primary Schools* (pp. 91–119). Teaching for the Future. Sense Publishers.

Rauch, F., & Steiner, R. (2013). Competences for education for sustainable development in teacher education. *Center for Educational Policy Studies Journal*, *3*(1), 9–24. https://doi.org/10.26529/cepsj.248

Rebolj, N., & Devetak, I. (2012). Teachers' opinion about the development of environmental competences in primary school. In M. Orel (Ed.), *EDUvision 2012 Modern Approaches to Teaching Coming Generation* (pp. 497–506). EDUvision.

Reed, S. K. (2010). *Cognition: Theories and application* (8th ed.). Wadsworth Cengage Learning.

Regulation of Textbook Approval. (2015). Official Gazette of the Republic of Slovenia, 2nd paragraph (no. 34/15 and 27/17). http://www.pisrs.si/Pis.web/pregledPredpisa?id=PRAV12484#

Rieckmann, M., Mindt, L., & Gardiner, S. (2017). Education for Sustainable Development Goals: Learning Objectives. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000247444

Reid, D. J., Briggs, N., & Beveridge, M. (1983). The effect of pictures upon the readability of a school science topic. *British Journal of Educational Psychology*, *53*(3), 327–335. https://doi.org/10.1111/j.2044-8279.1983.tb02565.x

Roberts, K., Benson, A., & Mills, J. (2021). E-textbook technology: Are instructors using it and what is the impact on student learning?. *Journal of Research in Innovative Teaching & Learning, 14*(3), 329–344.

Roczen, N. (2011). Environmental competence: the interplay between connection with nature and environmental knowledge in promoting ecological behavior. [Doctoral dissertatino (Research TU/e / Graduation TU/e), Industrial Engineering and Innovation Sciences]. Technische Universiteit Eindhoven. https://doi.org/10.6100/IR719557

Shalgimbekova, K., Eremeeva, O., & Pronkin, N. (2023). How the teacher's choice of e-textbook affects the primary school students' performance?. *Education And Information Technologies*, 1–14. https://doi.org/10.1007/s10639-023-11937-9

Stará, J., Chvál, M., & Starý, K. (2017). The role of textbooks in primary education. *E-Pedagogium*, *17*(4), 60–69.

Sternberg, R. J. (2003). *Cognitive theory* (3rd ed.). Thomson Wadsworth.

Stylianidou, F., Ormerod, F., & Ogborn, J. (2002). Analysis of Science Textbook Pictures about Energy and Pupils' readings of them. International Journal of Science Education, 24(3), 257–283. https://doi.org/10.1080/09500690110078905

Šorgo, A., Čeh, B., & Slavinec, M. (2013). *Aktivno v naravoslovje 2. Učbenik za naravoslvje v 7. razredu osnovne šole [Active in the science 2. Science textbook for 7th grade of primary school]*. DZS.

Šorgo, A., Dojer, B., Golob, N., Repnik, R., Repolusk, S., Pesek, I., ... & 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.

Šorgo, A., Glažar, S. A., & Slavinec, M. (2012). *Aktivno v naravoslovje 1. Učbenik za naravoslvje v 6. razredu osnovne šole [Active in the science 1. Science textbook for 6th grade of primary school]*. DZS.

Štraus, M., Repež, M., & Štigl, S. (2007). *Program mednarodne primerjave dosežkov učencev – OECD PISA - Naravoslovni, bralni in matematični dosežki slovenskih učencev*. Nacionalni center PISA. Pedagoški inštitut [Program for International Student Assessment - OECD PISA - Slovenian students' performance in science, reading and mathematics. National PISA Center. Pedagogical Institute]. https://www.pei.si/wp-content/uploads/2018/12/PISA2006NacionalnoPorocilo.pdf

Tome, S., Ravnjak, B., Glažar, S.A. & Repnik, R. (2016). *Ste jo videli že, srno?. Naravoslovje za 7. razred osnovne šole [Have you seen her yet, the doe?. Science textbook for 7th grade of primary school]*. Modrijan.

Torkar, G., Devetak, I., & Kovič, M. (2012). *Dotik narave 6. Učbenik za naravoslovje v 6. razredu osnovne šole [Touch of Nature 6. Science textbook for 6th grade of primary school]*. Rokus Klett.

Wade, R. & Eland, W. (1995). Connections, rewards, and challenges. *National Society for Experiential Education Quarterly, 21*(1), 4–5.

Yurtsever, N., & Angın, D. E. (2022). Examining the mediating role of altruism in the relationship between empathic tendencies, the nature relatedness, and environmental consciousness. *Center for Educational Policy Studies Journal, 12*(1), 217–239.

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