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Visual representation of the curriculum in geography textbooks: quantification of visuals in educational medium analysis

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Abstract

One of the most important components of the textbook is visuals which might facilitate the learning process. In some cases, however, due to their inconvenient structure, misconceptions might arise. The aim of this study is to analyse and evaluate how convenient the structure of visuals represented in the curriculum in Czech geography textbooks is. For this purpose, we have used an expert evaluation of visuals in 16 textbooks by the quantitative content analysis method. Visuals were categorised into groups based on four analysis criteria: type of visual, headline, thematic focus and colour. We were also interested in the space assigned to visuals in the textbook. The results of the analysis show that the key visual feature in geography textbooks is photographs, whose educational value is far less in comparison to other kinds of visuals. The amount of visuals without any caption is rather alarming. In contrast, there is a high proportion of coloured visuals which might have a positive effect on the learning outcome.

Keywords: Visuals, Geography textbook, Textbook analyses, Visual component of the textbook, Visual research

1. Introduction

Modern society uses a variety of methods to present data of various characteristics (Kirk, 2016). Nowadays, the most widespread method is probably the visualisation process in which data, both numerical and textual, is represented or displayed as so-called visuals (Spousta, 2007). The user must perceive and process visuals by other cognitive processes than when textual information is perceived

and processed (Mayer, 2009; Paivio, 2014). In the context of mental functions, so-called visual processes are used which might have a fundamental impact on understanding, remembering, and further operating with the presented information (Sternberg & Sternberg, 2012).

When teaching geography, visuals are included in various didactic resources, for example, atlases, digital materials, wall maps, and workbooks. Probably the most used didactic tool – the textbook – also contains a large amount of visuals with various characteristics. Textbooks as educational media that combine textual and visual information have considerable potential to make the learning and memorizing process more effective (Mayer & Gallini, 1990; Mikk, 2000; Behnke, 2017). However, in some cases, due to inappropriate visual (external) representation of the curriculum, the educational potential may not be fully utilised; field-didactic researches even propose that some properties of visuals might be the cause of misconceptions (e.g. Dove, Everett & Preece, 1999; Cook, 2008; Testa, Leccia & Puddu, 2014). The sophisticated structure of visuals in textbooks might be responsible for the variability of their impact on learning and motivation for students of various age groups (cf. Gerber, Boulton-Lewis & Bruce, 1995; Postigo & Pozo, 2004; Ainsworth, 2006). In addition to user research, expert research of visuals can identify potential problems in the structure and position of visuals in textbooks (Ysar & Seremet, 2007; Bláha, 2010; Rønningen, 2010).

The basis for evaluating the suitability of visual structure in textbooks in relation to the potential quality of students' learning can be by means of quantitative content analysis. Although this research method is quite commonly used in the research of visual structure in textbooks (e.g. Boughanmi, 2011, Slough et al., 2010; Janko, 2012), few studies compare textbooks for primary (elementary) and secondary (high) schools (cf. Wahla, 1983; Gerber, 2003). Therefore, this study fills a gap in our knowledge of research into the visual component of textbooks in the two age categories or school levels. This study can help to identify differences between Czech and foreign textbooks, using geography textbooks as examples, and specially to evaluate the educational potential of visuals in textbooks.

The aim of this study is to evaluate how suitable the structure of visual representation of the curriculum in textbooks is, using Czech geography textbooks as an example. The article presents the results of quantitative content analysis of the visual structure in textbooks for primary and lower secondary school students; also, common signs and differences in the visual structures are compared for

both age cohorts. Last but not least, the results of analyzing textbooks by individual publishing houses are compared, too.

Visual representation of curriculum in textbooks

When defining a textbook as an educational medium one may proceed from a general theory of systems. The textbook might be described as a structural system whose components and elements interact. It is possible to define a textual and visual component in this educational medium (Průcha, 2014, p.94). The visual component of the textbook includes various types of visuals which may be defined as the representation or depiction of a real phenomenon in the form of external information representation (Spousta, 2007, p.30). Visuals concretise, organise, represent and transform the curriculum into a visual representation of phenomena (Carney, Levin & Anglin, 1987). According to the dual coding theory (Paivio, 2014) and the theory of multimedia learning (Mayer, 2009), when processing information from visuals the student must use both verbal and non-verbal (visual) channels to receive information and a range of visual cognitive processes (e.g. memory, thinking, etc.) – (Sternberg & Sternberg, 2012).

Students might not have enough experience with using these mental processes (McTigue, 2009). Therefore, visuals should have suitable structures and features in textbooks in relation to the students' cognitive, competence, and affective preconditions to facilitate the process of learning (Ainsworth, 2006; Bresciani & Eppler, 2015). A number of empirical studies in the field of cognitive and pedagogical psychology (overview e.g. Carney & Levin, 2002) or cognitive cartography (Verdi & Kulhavy, 2002) show a different influence of structure and visual characteristics on the course and outcome of the learning process.

The specificity of geography textbooks compared to other subjects is precisely the position of visuals in the educational medium. Some authors even refer to this subject as a visual field (e.g. Gregory, 2009; Lukinbeal, 2014). Geography textbooks should thus contribute to the development of map skills and graphicacy (Hemmer, Hemmer & Bagoly-Simó, 2011) as key geographical skills (Řezníčková, 2003). Several studies on visual analysis confirm that geography textbooks include a higher proportion of visuals and a higher proportion of photographs and maps than in textbooks of other subjects (Janko & Pešková, 2013; Trahorsch, Bláha & Janko, 2018). However, the position of visuals is questionable in geography textbooks with regard to the context in which they are located (e.g., does not develop higher cognitive functions, predominantly decorative meaning, etc.) – (e.g. Ysar & Seremet, 2007; Hemmer, Hemmer &

Bagoly-Simó, 2011; Boughanmi, 2011). In the Czech geography textbooks, the share of real visuals is traditionally much higher than in other countries (Janko, 2015; Trahorsch, Bláha & Janko, 2018).

User researches of visuals (not only) in geographical education show that a lot of factors influence the effectiveness of learning from visuals (e.g. Havelková & Hanus, 2018). The authors of this study focused on factors that are related to the visual characteristics, not on factors related to users (e.g. their motivation, experience) or external factors (e.g. daily time for learning, characteristic of education). The authors chose a total of five factors that were found by a variety of empirical studies to have an impact on the effectiveness of learning. These factors (analysis criteria) include the total space occupied by visuals in the textbook, the type of visual, the presence or absence of captions, the thematic focus, and the use of colour. According to the mentioned criteria it is the visuals' structure that can provide feedback on the educational potential of visuals in geography textbooks to groups interested in textbook production.

A primary factor influencing students' learning is the layout of the textbook page and the amount of visuals and text in particular. If the page is overfilled with text, students' motivation to use the educational medium is considerably reduced; on the other hand, in the case of an extensive amount of visuals, the functions of explanatory text are not fully utilised therefore the educational potential of visuals is also reduced (Behnke, 2017).

Certain structural features of visuals also have a great influence on the effectiveness of learning. The first factor that significantly influences the effectiveness and strategy of learning from visuals is their type. By type, we mean a certain group of visuals with identical means of displaying or depicting data (e.g. axes in a graph, a simplified model visualizing spatial relations, etc.). For example, Bertin (1967), a standard author of visual semiology, or other reserachers into visual research in the psychology and pedagogy field (e.g. Veriki, 2002; Janko, 2012) distinguish the type of visual as a *map* (visualisation of spatial relations), *graph* (quantitative data visualisation using mostly the Cartesian coordinate system), or *scheme* (a simplified model of a real phenomenon). It is necessary to assign a photograph as a realistic visualisation to these three basic types of visuals (Rose, 2008). Other visuals do not have a sophisticated system of expressing means and may be categorised as 'other': e.g. pictograms, flags, logos. One may prefer to use more realistic visuals for younger students who have not yet developed the cognitive abilities to process abstract visuals, which offer more educational potential for older students (Gerber,

Boulton-Lewis & Bruce, 1995; Jones, 1998). The structure of the type of visuals should, however, be varied so as not to lead to stereotyping of regions (Barrett & Farroni, 1996; Kučerová, Kučera & Novotná, 2018).

Another external element of visuals that influences the effectiveness of learning is captions. The presence of a caption activates the student's attention to this element of the textbook and therefore has the potential to facilitate learning. When the visual is not captioned, it is overlooked by the student and is not perceived as a relevant element of the textbook (Mayer & Gallini, 1990; McTigue & Flowers, 2011). The absence of a caption might cause the student to overlook the visual, perceive it as a decorative element without educational potential or misunderstand the visualised phenomenon.

A key factor influencing learning from visuals is their thematic focus. The thematic focus is related to the visualised phenomenon (i.e. what the visual depicts; Wright, 1979), or the location of the visual in the textbook (i.e. where the visual is located; Zhang & Foskett, 2003). Nevertheless, the current state of knowledge about learning from various thematically-focused visuals is inconsistent. New studies show that students understand physical–geographical phenomena better through photographs. However, socio-economic phenomena are more effective when presented in the form of abstract visuals (cf. Jones, 1998; Michaelidou, Nakos & Filippakopoulou, 2004; Klonari, 2012).

The colour of visuals influences mainly the associativity of the real phenomenon with a certain element (part) of the visual. Visuals that are only black and white reduce the effectiveness of learning because students navigate through them poorly (Ozcelik et al., 2009). Currently, the number and proportion of coloured visuals in textbooks is increasing which is connected with relatively economical colour printing as well as the use of information technology when creating visuals (Dodge, McDerby & Turner, 2008).

Methodology of visuals' structure analysis

Research design

The research can be categorised as a visual research (Mayer, 2009), namely in the category of expert assessment of visuals; the essence of this research group is the focus of the evaluator (expert, not the user himself) on different types of visuals (Bláha, 2010). This study focuses on the manifest content of visuals. This methodology is based on categorizing the external (apparent) features of visuals, which were relatively possible to objectively evaluate; unlike latent content analysis, the evaluator is not forced

to analyse the depth structure of the visual (cf. Trahorsch, 2018). During the analysis, individual visuals are put into groups (categories) based on their common features in the external structure (Krippendorff, 2004; Bláha, 2010; Trahorsch, Bláha & Janko, 2018). Categories are pre-defined and clearly defined. Since the analysis focuses only on visuals, it cannot be described as multimodal.

Study group

Sixteen geography textbooks were selected, from which 3,507 visuals were analysed: specifically, eleven textbooks for primary schools (2,076 visuals) and five for lower secondary schools (1,431 visuals). The reason for selecting these two groups of textbooks is their common thematic focus on the Czechia, which allows analysis of the development of the visuals' structure depending on the age of users and comparison of the two groups of textbooks. Another requirement for selection was the up-to-dateness of the analysed titles (the textbook was not allowed to be more than ten years old at the time of evaluation) and a clause by the Czech Ministry of Education that guarantees a certain subject field-didactic quality of the educational medium. In all the textbooks, only the educational content related to the Czechia was analysed which ensured at least partial comparability between the two groups. Introductory pages including the table of contents were not analysed, neither were the final pages, which usually included the affiliation of the textbook. Table 1 shows an overview of the analysed textbooks.

Textbook	Age group	Publishing house	Total extent (pages)	Analysed range (%)	Number of visuals in the analysed range
Čechurová, Ježková & Borecký (2016)	primary	SPN	11	53.1	275
Štiková & Tabárková (2016)	primary	Nová škola	6	89.1	205
Matušková & Šmolíková (2010)	primary	Septima	5	78.8	141
Hroudová & Cimala (2013)	primary	Nová škola – Duha	60	86.7	256
Smolová & Szczyba (2008)	primary	Prodos	96	49.0	185
Mandelová (2007)	primary	Dialog	112	27.7	151
Viceníková, Sakařová & Kamrla (2016)	primary	Taktik	64	82.6	317
Hublová (2009)	primary	Didaktis	95	33.7	157
Matušková (2010)	primary	Nakladatelství ČGS	88	63.6	235
Chalupa (2010a)	primary	Alter	44	84.1	59
Chalupa (2010b)	primary	Alter	52	90.4	95
Borecký, Novák & Chalupa (2013)	lower secondary	Nová škola – Duha	96	85.4	263

Voženílek & Szczyba (2015)	lower secondary	Prodos	112	94.6	275
Chalupa, Horník & Demek (2015)	lower secondary	SPN	112	95.5	442
Marada, Havlíček, Matějček, Hanus & Chromý (2016)	lower secondary	Fraus	136	52.2	221
Kastner, Holeček & Krajíček (2016)	lower secondary	Nakladatelství ČGS	104	95.2	230

Table 1: Overview of the analysed textbooks with their basic characteristics. Note: the textbook by Alter publishing (Chalupa, 2010b) will be referred as Alter (RG) further in the text, as it focuses only on the regional geography unlike the textbook Chalupa (2010a).

Data collection and data analysis

When analysing visuals in textbooks we focused on the overall space occupied by the visuals, the type of visual, the presence of captions, the thematic focus of the visual and its use of colour (see the factors mentioned above).

To determine *the amount of space occupied by the visuals*, we used a methodology already applied by Bláha and Kučera (2014) which consists of dividing a page into halves, quarters, fifths, etc. The evaluator then estimates the approximate proportion of the page filled with visuals or text. The result for the whole textbook is then calculated as the average of all analysed textbook pages. Other indicators for measuring the quantity of visuals include the average number of visuals (and various types of visuals) per page (Metallinos et al., 1990) and the number of pages with a minimum of one visual (Tang, 1994).

The system for categorising the *type of visual* is based on a simplified and already standardised methodical tool used by Janko (2012; 2015) and Fedotova, Latun & Okuneva (2014). The authors proceeded to simplify this system because in this author's work some of the categories are not independent (e.g. according to the cited author, two cartographic and cartographic-statistic categories are based on the visualisation of the spatial relations). The established categories are further in agreement with visualisation theories (Bertin, 1967; Rose, 2008; Kirk, 2016). By uniting the categories into logically larger units, the reliability of the research tool is thus improved in terms of content analysis.

The categorisation of *captions* was done by sorting visuals into two groups: the presence or absence of caption describing the visualised phenomenon. The same methodology was used by McTigue, Kim & Jennings (2010) as well as Khine & Liu (2017) in their analysis of visuals in science textbooks.

Categories of *thematic focus* of the visual are based on the dualistic concept of geography. Two sub-disciplines are usually earmarked within this concept (e.g. Gregory, 2009; IGU, 2016), namely

physical geography and socio-economic geography (also social geography). Regional geography also cuts across these sub-disciplines, which deals with the relationship between nature and society in regions. Moreover, a category of cartography had to be added to the categorical system, where basic cartographic concepts are visualised, for example the mapping of Czech regions. When categorising the visuals, the key criterion was the presence of the analysed visual in a certain thematic unit of the textbook because the pilot testing showed (see below) that analysis based on the depicted phenomenon is not accurate due to the complexity of geography.

The use of colour of visuals was categorised only in two groups, namely coloured and monochromatic. This ensured comparability with other studies (e.g. Melbo & Waterman, 1936; Evans, Watson & Willows, 1987; Metallinos et al., 1990).

The overview of all criteria and analysis categories with their brief description is stated in table 2.

Analysis criterion	Analysis criteria	Brief description
Type of visual	Map, map drawing	Two-dimensional model structure of spatial relations
	Graph and diagram	Quantitative data visualisation in axes or a pie chart
	Scheme	Simplified model of presented phenomenon
	Photograph, realistic drawing	Real visualisation of the real phenomenon
	Others	Not possible to put in other categories (e.g. flags, logos)
Caption	Presence of the heading	Caption describes the visualised phenomenon
	Absence of the heading	No caption describing the visualised phenomenon
Thematic focus of the visual	Physical geography	The visual relates to natural elements of the Czechia (e.g. surface, climate, etc.)
	Socio-economic geography	The visual relates to social and economical elements of the Czechia (population, industry, etc.)
	Regional geography	The visual relates to regions of the Czechia (e.g. regions, my home)
	Cartography	The visual relates to the presentation of cartographic curriculum using the example of the Czechia
	Others, not specified	The visual is not related to the topic mentioned above (e.g. location, history)
Use of colour	Fully-coloured	The visual includes shades of multiple colours (polychromatic)
	Monochromatic	The visual includes shades of only one colour

Table 2: Analysis criteria of visuals, analysis categories and their brief description

The research tool was presented to three experts in pedagogy, didactics, and geography education and was then modified based on their comments. This ensured validity of the research tool by

the method of triangulation (Cohen, Manion & Morrison, 2007). A pilot survey was carried out before the analysis which allowed the specification of further categories. At the beginning of the content analysis of visuals, all three experts cooperated while categorizing which helped to clarify some categories in analysis. The results of the analysis, in the form of relative and absolute frequencies, were then analysed by simple statistic tests designed for nominal data (e.g. chi-square test for four-field table or contingency table) at a significance level α=0,05 (Cohen, Manion & Morrison, 2007; Hendl, 2012).

Analysis results

Key findings of the analysis are presented, structured into two parts: results of the analysis of visuals in primary and lower secondary school textbooks (and differences in visual structure between primary and lower secondary school textbooks), and fundamental differences between textbook publishers. Interpretation of results is based on data from table 3.

Analysis of results of visual structure in textbooks and comparison of textbooks for primary and secondary school

The results show that the space occupied by visuals in the geography textbooks is rather large. In all analysed textbooks, there is at least one visual on 93% of the pages; there is no statistically significant difference between the groups of textbooks studied ($p = 0.24$). However, as the age of users increases, the number of visuals decreases. This is evidenced by the results of the average number of visuals per page and the average space per page occupied by visuals. This increases the range of text to the exclusion of the overall visuals' area. On average, visuals occupy over a third of a page.

Regarding the type of visuals, real visuals (photographs and real drawings) have a key role in textbooks for both levels of education. On the other hand, abstract and quantitative visuals (e.g. graphs and diagrams) are marginal. However, there are differences between textbooks for younger and older students. The proportion of maps, graphs, and schemes is higher in textbooks for older students than for younger students ($p<0.01$). Conversely, the representation of photographs is no different in textbooks for either group ($p=0.56$). Furthermore, in the textbooks for younger students, the proportion of motivational pictures (drawings), i.e. the category “others”, decreased. Figure 1 on the left shows a typical example of a photograph without greater educational potential (decorative photographs of Sněžka mountain); Figure 1 on the right shows an example of motivational visual typical of primary school textbooks (category: others).

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Figure 1: Example of decorative photograph (left) and motivational picture from primary school textbook (right)

The representation of visuals without *captions* is rather alarming, with a high proportion of visuals having no caption. In primary school textbooks, the proportion of visuals without captions is 25.7 %, while in lower secondary education textbooks it is 11.8 %. According to the chi-square test, the difference between the number of visuals in textbooks for both types of schools is statistically significant ($p<0.01$). An example of a visual without a caption is figure 2 (left). The absence of a caption may cause misunderstanding of the map content.

The number of visuals for individual topics in textbooks depends on the order of the geography curriculum within elementary education. From a *visuals' thematic focus* standpoint, the visualisation of regional geography is particularly important and the importance of visual representation increases throughout the school years: in textbooks for lower secondary schools, less than two-thirds of the visuals are located in the chapters about the regions of the Czechia. The vast majority of these are photographs of important cultural monuments and natural specifics of regions. On the other hand, the proportion of visuals in other chapters (cartography, physical geography, socio-economic geography) decreases with the age of users, although these topics are very abstract and visuals could contribute to improved learning. The chi-square test showed that differences in thematic focus of visuals between primary and lower secondary school textbooks are statistically significant ($p<0.01$). Figure 2 (right) shows a typical landscape image of Northwest Bohemia (mining, heavy industry); students could thus stereotype the region, although it has a naturally valuable area in the region.

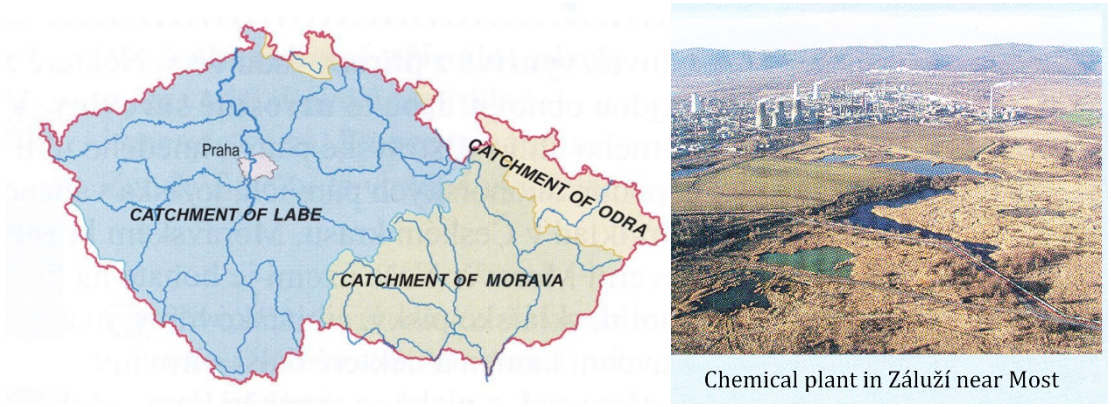

Figure 2: an example of a missing caption in the visual (left) and a stereotyping photograph of the Czech region

Coloured visuals dominate (96.1 % in primary school textbooks and 99.3 % in lower secondary) in modern geography textbooks. The chi-square test showed that the difference in colour visual representation between primary and lower secondary school textbooks is statistically significant ($p<0.01$).

Table 3 shows a comparison of results between the geography textbooks.

Analysis criterion	Analysis categories	Primary education (%)	Lower secondary education (%)
Area of visuals	Proportion of the area of visuals in the textbook	45.7	35.7
	Proportion of pages with a minimum of one visual	91.0	95.0
	Average number of visuals per textbook page (number of visuals/page)	4.3	3.1
Type of the visual	Photographs	68.3	69.2
	Graphs and diagrams	0.1	5.9
	Maps and map drawings	15.2	18.3
	Schemes	4.8	2.9
	Others	11.6	3.8
Heading	Presence of caption	74.3	88.2
	No caption	25.7	11.8
Thematic focus	Physical geography	19.7	16.5
	Socio-economic geography	22.9	14.1
	Regional geography	35.7	62.2
	Cartography	8.5	0.3
	Other	13.3	6.9
Colour	Coloured visuals	96.1	99.2
	Monochromatic visuals	3.9	0.8

Table 3: Comparison of results between primary and lower secondary school textbooks

Comparison of individual publishing houses

The area of visuals and text in the textbooks by individual publishing houses is highly variable and is related to the overall concept of the textbook. The textbook by Alter publishing house uses the smallest area for visuals and is characterised by excessive text for younger students (visuals represent only 28 % of the area). On the other hand, the largest area of visuals is in the textbook by the publisher Taktik (visuals represent almost two-thirds of the area).

Regarding the type of visuals, textbooks for lower secondary education have the most balanced structure. A very one-sided structure in terms of visuals' type is seen in the textbook by Alter focusing on regional geography (Fig. 3), which supports the thesis concerning the excessive number of photographs in chapters focused on regional geography of the Czechia.

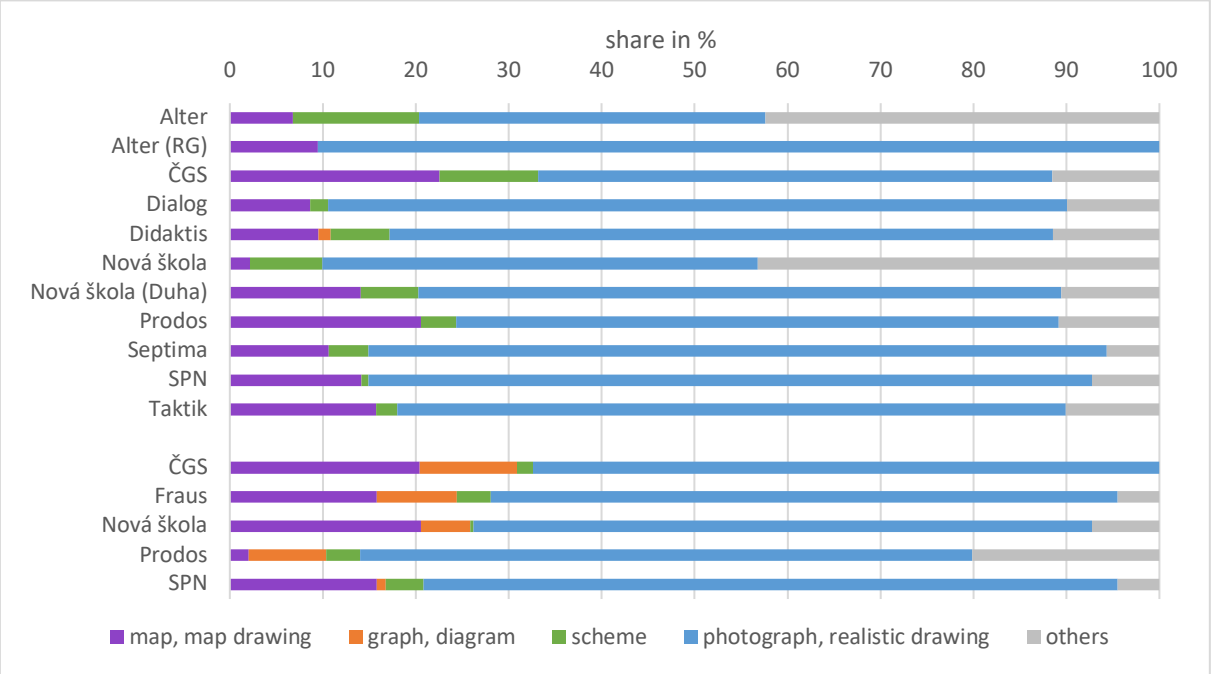

Figure 3: The structure of visuals' type according to individual publishing houses

The number of visuals without captions as a propotion of the overall number of visuals is more balanced among publishing houses producing textbooks for lower secondary education in comparison to those which produce textbooks for primary schools. It is alarming that in two textbooks for primary education (Prodos and Nakladatelství ČGS) the proportion of visuals without captions is higher than 50 %.

There are also differences in the thematic focus of visuals (see Fig. 4). For primary education, very few of the publishers placed more than 50 % of visuals in chapters about regional geography of the Czechia. On the other hand, four out of five publishers for lower secondary education geography

textbooks paid considerable attention to the visualisation of regional geography (more than 60 % of visuals are placed in this chapter in four textbooks). This means a lower representation of visuals in physical-geography and socio-economic topics which may, due to their abstractness and complexity, cause learning difficulties to students. In the category "other" in textbooks for primary education (e.g. Septima, Nakladatelství ČGS) there is a higher representation of visuals related to the curriculum relevant to the location where students live or the visualisation of key historical events.

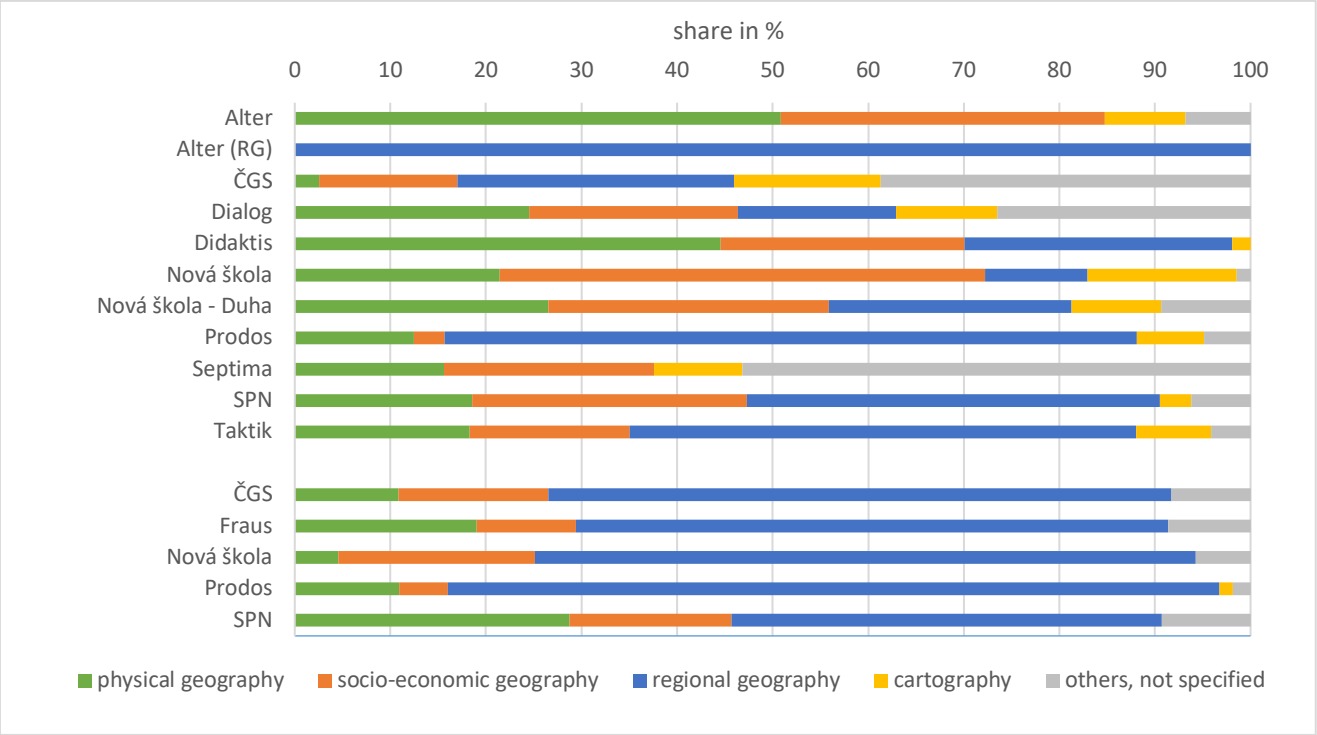

Figure 4: Structure of thematic visuals' focus by individual publishing houses

There are no significant differences between individual publishers (except for the primary education textbook by Nakladatelství ČGS): for most publishers, the proportion of monochromatic visuals is less than 4%, but this rises to 20 % in the textbook by Nakladatelství ČGS.

Discussion

The results of the analysis will now be discussed in the context of other studies of similar focus. Furthermore, the results will be compared with user visual research, which should contribute to the detection of shortcomings in the visualisation structure of the curriculum in textbooks.

The results showed a considerable use of visuals. This characteristic of geography textbooks is also supported by other authors (e.g. Slough et al., 2010; Janko, 2012; Janko & Pešková, 2013; Fedotova, Latun & Okuneva, 2014, Janko, 2015 and others). A specific feature of Czech textbooks is the high

proportion of photographs at the expense of other types of visuals (especially abstract visuals) – (Wahla, 1983; Trahorsch, Bláha & Janko, 2018). This is probably due to the perception of geography as a complementary school subject: geography has long been perceived as an insignificant subject in the Czechia (Knecht & Hofmann, 2013), which may be exacerbated by overcrowding of textbooks with real visuals, often without educational potential. On the other hand, a high proportion of untitled visuals can also be seen in other countries' geography textbooks; Czech geography textbooks are no different in terms of this criterion (e.g. Tang, 1994; Slough et al., 2010).

All geography textbooks include multicoloured visuals. Their high frequency definitely relates to better printing possibilities and publishers having good information technology that allows for easy creation and editing of visuals (Dodge, McDerby & Turner, 2008). The proportion of multicoloured visuals in Czech geography textbooks, as in other countries of the world, has significantly increased in recent decades (cf. Melbo & Waterman, 1936; Metallinos et al., 1990).

The results show some differences between geography textbooks for primary and lower secondary schools. There is an increasing number of abstract types of visuals (especially graphs and maps), a greater number of visuals for regional geography topics compared to other topics, and a lower proportion of visuals with captions. This might be due to the different functions of visuals in textbooks for primary schools, mainly reducing the proportion of visuals with decorative and aesthetic function (Carney, Levin & Anglin, 1987).

In terms of user potential, the structure of visuals in geography textbooks can be assessed negatively. The educational potential of visuals is reduced by the narrow range of visual types and lack of abstract visuals (Mayer & Gallini, 1990; Gerber, Boulton-Lewis & Bruce, 1995; Mayer, 2009). Students do not have the opportunity to develop their abstract visual thinking, because they are given minimal opportunities in textbooks. Authors may be expected to progressively develop cognitive abilities; however, students need to be taught how to work with abstract types of visuals (e.g. a bar graph showing absolute values referring to a table with data), as they may have difficulty working with these abstract visuals after transferring to lower secondary school (Postigo & Pozo, 2004). Further, photography has a much greater affective impact in comparison with abstract visuals, which evoke rather the learning of facto-graphical knowledge (Gerber, Boulton-Lewis & Bruce, 1995; Postigo & Pozo, 2004). Photographs of important monuments are most often placed in textbooks (e.g. Fig 1), which may try to impress the

aesthetic perception of the user (student and teacher) and motivate them to buy the product (commercialisation) – (also see Benson, 1997). This statement is supported by a high representation of visuals (especially photography – see Fig. 2) for regional geography, which does not correspond to the current concept of geographic education (e.g. IGU, 2016). Photographs of regions then very often lead to stereotyping of regions and thus to the emergence of misconceptions (Barrett & Farroni, 1996; Kučerová, Kučera & Novotná, 2018).

One may also perceive a relatively high proportion of visuals without captions as being problematic. Without captions, the student does not perceive the visual as a relevant textbook item and does not focus on it, which reduces learning efficiency (McTigue & Flowers, 2011).

Despite these negatives, there are findings that have the potential to support the effectiveness of student learning. First of all, there is a high representation of colour visuals that can have a positive impact on students' learning (Ozcelik et al. 2009). Next, there is a reasonable proportion of visuals on the page; the combination of text and visuals can contribute to improved learning (which of course depends on many other factors, e.g. the arrangement of compositional elements, etc.) – (Peterson, 2016; Behnke, 2017). One may positively evaluate the greater representation of visuals in textbooks as having a motivational effect, developing visual literacy or promoting higher cognitive functions (Mayer & Gallini, 1990).

Conclusion – the educational potential of visuals in geography textbooks

Visuals have prominence in geography textbooks because they usually account for more than a third of the area of the textbook. Although they may currently be considered a key structural component of the textbook (cf. Melbo & Waterman, 1936; Janko, 2012), their structure and some features do not match their educational potential. The fundamental prevalence of photographs does not develop the students' abstract thinking enough. Recurring photographs of famous monuments or characteristic phenomena of a certain region might lead to the stereotyping of regions in the Czechia and thus to misconception (cf. Barrett & Farroni, 1996; Kučerová, Kučera & Novotná, 2018). A relatively high proportion of visuals without captions might significantly reduce the effectiveness of learning from a printed medium. Regarding the concept of geographical education (e.g. IGU, 2016), one may see the great emphasis on the visualisation of regional geography of the Czechia as problematic.

The limit of this study may be its focus on the content of visuals. The aim of the study is not to evaluate the quality of visualisation, only its structure and selected features using nominal data. In the case of evaluating the quality of visuals, it would be necessary to use different methods (cf. e.g. Bláha, 2010; Trahorsch, 2018). The focus of this study is manifested by the use of simple category systems that do not aim to provide a very detailed overview, but which should reveal general tendencies in the use of visuals in geography textbooks for primary and lower secondary education.

Regarding the content analysis of visuals in didactic terms, it would be appropriate to evaluate visuals in electronic teaching materials in future. These teaching materials have different quality criteria for users compared to printed textbooks (e.g. interactivity, dynamics of visualisation, etc.).

Visuals should be included in geography textbooks based on a well-thought-out selection of findings and recommendations from multi-disciplinary authorial teams (e.g. field didactic specialists, developmental psychologists, educators, graphic designers, authors of the texts, etc.). This selection should take into consideration both the user's characteristics (age, cognitive processes, interests, motivation, etc.) as well as the potential use of this didactic tool in teaching (e.g. problem-based tasks and the combination of various kinds of visuals). These criteria while selecting visuals might be more beneficial to the process of learning than is the case in current textbooks.

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