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Research Article

Critical Spots and Misconceptions in Students' Understanding of Problems and Challenges in Europe

Martina Škodová ¹✉, Tibor Madleňák ¹ & Michaela Mihoková ¹

¹ Matej Bel University in Banská Bystrica, Slovakia

✉ Correspondence: martina.skodova@umb.sk

Abstract: Europe is currently undergoing dynamic change. European countries, regions, and populations face numerous economic, social, political, and environmental challenges. Reflection within the educational process plays a key role in understanding and responding to these developments. Teaching regional geography offers a suitable framework for such reflection. The regional geography of Europe holds strong potential for fostering understanding of diverse, complex, and often difficult issues. The aim of this study is to identify critical spots and common misconceptions in students' understanding of problems and challenges in Europe. The study addresses the following research question. What critical spots and misconceptions appear in students' understanding of European issues? The paper presents results from research focused on the most frequent misconceptions related to selected problematic topics in European geography. The research sample consisted of 304 students from selected secondary schools in Slovakia. Data were collected using a testing method applied after completion of a thematic unit on the regional geography of Europe. Statistical analysis conducted in RStudio confirmed the persistence of several misconceptions. These concerned perceptions of Russia, democracy, nuclear energy, and population ageing. For example, 89.1% of respondents did not perceive Russia as a country with a relatively high share of Muslims. In addition, 71.7% believed Switzerland has the highest level of democracy in Europe, without considering that Nordic countries often rank higher. Misconceptions also appeared in relation to nuclear energy, with 67.6% viewing nuclear power as highly environmentally unfriendly, and population ageing, where 57.9% believed ageing occurs more slowly in Southern Europe than in Northern Europe.

Keywords: regional geography education; critical spots; misconceptions; questionnaire survey; Slovakia

Highlights:

- Teaching European issues should consider students' key difficulties and misconceptions.
- Slovak students exhibit several misconceptions in the examined topics of the regional geography of Europe.
- The revealed misconceptions underline the need for contextualized and critical geography education.

1. Introduction

Europe is currently undergoing profound and dynamic transformations. Individual countries, regions, and inhabitants are confronted with numerous challenges related to war, energy crises, population aging, irregular migration, separatism, climate change, environmental degradation, and the rise of political populism and extremism (Kriesi, 2014). In parallel with ongoing social, economic, technological, and environmental changes in Europe and globally, education must also adapt in order to prepare young people to cope with new conditions, confront contemporary challenges, and actively participate in shaping the future. School regional geography has considerable potential to develop a holistic understanding of complex phenomena and processes in the world and individual regions (Balciogullari, 2017). As Maude (2017) suggests, a geographical approach opens new ways of thinking, facilitates reflection on alternative futures and allows students to think beyond their own experiences. Therefore, school geography could respond adequately to current issues in Europe and the world (Meadows, 2020). However, based on a survey of professional literature (e.g., Campbell, 2008; Avery, Levy, & Simmons, 2013), geographical curricula, secondary school geography textbooks (Škodová, Sabo & Madleňák, 2024), and personal experience, we conclude that such responses are currently limited. There are several reasons: higher demands on teacher preparation, cross-cutting and dynamic topics, and a lack of time, among others. Regional geography in schools is defined as the study of regions that emphasizes their physical, social, cultural, and economic interconnections, as well as the links between local and global processes. Its place in school geography is not fixed but evolving. As Standish (2018) argues, regional geography remains essential because it enables students to engage with complexity, avoid oversimplification, and relate geographical knowledge to pressing societal and environmental challenges. Strengthening its curricular position is therefore well justified, given its contribution to both geographical education and broader civic and sustainability education. The issues and challenges currently facing Europe are inherently complex and difficult for students to comprehend. It can be assumed that greater cognitive demands increase the risk of misunderstanding and the persistence of misconceptions. Students often

simplify or distort information, and their understandings are further shaped by family influences, social networks, and media exposure. In addition to reliable information, students frequently encounter disinformation, hoaxes, and conspiracy theories (see Stecula & Pickup, 2021; Adjin-Tettey, 2022). We pose the research question: *What are the critical spots and misconceptions in students' understanding of problems and challenges in Europe?* The novelty of this research lies in its investigation of students' knowledge and conceptions regarding current European issues within the framework of school regional geography. Until now, research in the European context has focused more on physical geography, planetary geography, and cartography than on human and regional geography. Their occurrence may therefore be underestimated. In order to develop a series of innovative teaching materials focused on current issues and challenges related to Europe and its regions, supplementing the traditionally addressed content of regional geography, we investigated what knowledge and conceptions students hold about these topics, whether geographical education successfully shapes their understanding, in which areas students struggle due to complexity (critical spots), and which misconceptions they continue to maintain. Our research revealed that students were least successful in political geography topics, and also identified several misconceptions related to the perception of Russia, democracy, nuclear energy, and the aging of the European population.

2. Theoretical Framework

Several studies (e.g., Park & Oliver, 2008) argue that awareness of critical concepts and persistent misconceptions in specific subject areas is an important part of a teacher's knowledge of the pedagogical content for a particular teaching topic. Critical spots in teaching represent areas where students frequently encounter difficulties or fail to achieve the level of mastery required for deeper, productive application. Experts (de Guzman et al., 2017) perceive critical spots from different perspectives. From a teacher's perspective, it is a part of the curriculum that is not popular with teachers or that is didactically challenging. From an ontodidactic point of view, critical spots are considered to be topics that are fundamental from the perspective of the geography paradigm, nodes from which the curriculum branches into other branches, and topics important for practical life (but inherently difficult for students to understand). From a psychodidactic perspective, these are topics that are cognitively challenging to understand and have low student motivation. Such critical spots in the regional geography of Europe have been identified by Kuklinski et al. (2000) and Lutz & Bitschnau (2023).

Critical spots are often associated with a misunderstanding of particular laws, processes, and phenomena in the world, as well as various misconceptions. Incomplete knowledge and inaccurate conceptions are a natural part of cognitive development; however, when inaccurate conceptions persist, students build additional knowledge upon these flawed foundations. Such frequently occurring incorrect mental models that do not correspond to empirically observable reality are referred to as misconceptions. They cannot be identified with insufficient knowledge, and it cannot be claimed that every original (naive) or incorrect idea of a child is, or will become, a misconception (Weingartner & Masnick, 2019). Just like misconceptions and knowledge, misconceptions are natural and their occurrence is not limited to children – they often persist into adulthood (for example, the misconception that the whole of Iceland is covered with glaciers). At the school age, misconceptions and inaccurate conceptions are an integral part of the teaching process; teachers should detect, anticipate, and work with them (for example, by paying attention to why Iceland is not entirely covered with glaciers). Several causes of the emergence of misconceptions at the cognitive level of the student are discussed, for example, by Durkin and Johnson (2015) and Vosniadou (2020). In addition to the out-of-school environment, the school environment itself can also generate misconceptions – the teacher's interpretation of the phenomenon may be incorrect or may differ in different subjects (Smith, di Sessa & Roschelle, 1993).

The issue of researching misconceptions in geography is receiving increasing attention (Sam & Gibson, 2011). The professional literature more often describes critical spots and misconceptions in physical geography (e.g. Henriques, 2000; Likavský & Ružičková, 2004; Reinfried, 2006; Lane & Coutts, 2012; Arthurs, Hsia & Schweinle, 2015; Dove, 2016; Chang & Pascua, 2016; Pluháčková et al., 2019; Desfandi et al., 2020; Martín-Ramos et al., 2020), planetary geography (Gorecek Baybars & Can, 2018) and cartography (Ishikawa & Kastens, 2004), as well as in human and regional geography (Schoeman, 2015). Their occurrence may thus be underestimated. For example, Kocová & Marada (2020) found that students have more misconceptions in human geography than in physical geography. They justified this by saying that physical geography topics appear to be more challenging and therefore more emphasis is placed on their correct understanding during teaching. They also state that the human geography curriculum is characterized by a higher degree of alternatives and subjective perspectives in the perception of reality (on the part of both the teacher and the student), with less possibility of predicting critical spots and misconceptions by teachers. In human geography, there are also many factors that condition their emergence (family, peers, political elites, mass media, etc.).

There are only a few studies of critical spots and misconceptions in the regional geography of Europe (e.g., Francek, 2013; Kuklinski et al., 2000; Lutz & Bitschnau, 2023). They confirm that students have several misconceptions about this topic. Regional geography is challenging due to the complexity and intricacy of the phenomena and processes it encompasses. To gain a deeper understanding of the subject, students often follow their own and understandable justifications of phenomena, which leads to the emergence of misconceptions. Several misconceptions are related to the characteristics of cities and regions, for example, many students believe that Lapland is a state, that Iceland is covered in ice all year round, or that Norway is the northernmost country in Europe. Much more common, however, are misconceptions related to current social problems and challenges, such as migration and geopolitical issues (Mo-shou & Drinia, 2023; Lanosz & Bitschnau, 2023). There are several reasons. One of them is the generalization of certain phenomena (sometimes leading to the emergence of stereotypes), which, in a sense, simplifies orientation in an overly complicated and rapidly changing world. It is also common to hold polarized opinions on many topics that are rooted in perception rather than reality (Gorodzeisky, 2013). A sense of the need to protect one's group identity, personal interests, and security can also lead to a distorted perception of social phenomena. The consequence of incorrect perception is the tendency of students to trust unfounded rumors, prejudices, and various conspiracy theories. The reason is not that they are misinformed, but that they are misinformed – they hold objectively false beliefs (Kuklinski et al., 2000). An example is the misconceptions related to migration. For example, a significant portion of Europeans believe that immigrants are unwilling to integrate, that the European Union supports immigration, and so on (Lutz & Bitschnau, 2023). According to research by the Gapminder organization (2025), residents of Sweden, Denmark, Norway, Finland and the United Kingdom overestimate the number of refugees by up to ten times. Complex conspiracy theories are also common, e.g., about the alleged replacement of native Europeans by Africans or Middle Easterners (Bergmann, 2018). Another source of various misconceptions is the topic of climate change (Liu, Wang & Lin, 2014; Neumann & Fischer, 2022), as well as other environmental issues (Bryan & Tippett, 2006). Research focused on some of the most popular myths, e.g. that acid rain or ozone depletion cause climate change (Stylianou & Plakitsi, 2021), that a decrease in solar radiation will soon trigger cooling and a little ice age, that climate change is just part of a natural cycle (Gautier, Deutsch & Rebich, 2006), that scientists do not agree on the cause of climate change or manipulate data (Fleming et al., 2021), etc. Other misconceptions related to the topics the study focuses on are, for example,

that biomass burning is environmentally friendly (Desservettaz et al., 2003), that fossil fuels are no longer the primary source of energy, that more than a third of all plastic waste ends up in the oceans Gapminder (2025) or that nuclear power is environmentally very risky (Gökmen et al., 2010). Another example of a misconception is the stereotype of the “old North” and the “young South” (Zucchetti et al., 2021), as well as a range of other geopolitical misconceptions. An example of a geopolitically conditioned stereotype is the idea that Prague is located further east than Vienna, which is related to the persistent bipolar perception of Europe (Nováček et al., 2025). The misconception that authoritarian regimes and dictatorships are more effective in fighting corruption than democratic states (Mungiu-Pippidi, 2015) often appears in geopolitical discourse. Many misconceptions exist in connection with the war in Ukraine, e.g., that Crimea has always been Russian (Plokhly, 2016), that the annexation of Crimea is an example of separatism (Kuzio, 2015) or the incorrect idea that Russian-speaking residents of Ukraine can automatically be considered Russians (Kulyk, 2011). Research suggests that not only students, but also future and current teachers, hold several misconceptions regarding these topics (Celikler & Kara, 2011; Tolppanen, Claudelin, & Kang, 2021).

Previous studies indicate that awareness of critical spots and misconceptions is a key element of teachers' pedagogical content knowledge (Park & Oliver, 2008). Misconceptions and critical spots have been documented across multiple subfields of geography, including physical geography, planetary geography, cartography, and human and regional geography (Henriques, 2000; Dove, 2016; Gorecek Baybars & Can, 2018; Schoeman, 2015). Empirical evidence suggests that students exhibit a higher prevalence of misconceptions in human geography compared to physical geography, primarily due to the greater variability and interpretative flexibility inherent in human geography topics (Kocová & Marada, 2020). Research on regional geography of Europe remains limited but confirms that students hold various misconceptions regarding both physical features and contemporary socio-political issues (Francek, 2013; Kuklinski et al., 2000; Lutz & Bitschnau, 2023; Moshou & Drinia, 2023). These misconceptions are shaped not only by cognitive complexity and prior knowledge, but also by social, cultural, and media influences (Gorodzeisky, 2013; Gapminder, 2025).

This study contributes to the field by identifying several critical spots and misconceptions in secondary school students' understanding of European regional geography. Particular emphasis is placed on contemporary socio-political and environmental challenges, areas that have been comparatively underexplored in previous research.

3. Materials and Methods

The research aimed to identify critical spots and misconceptions in the knowledge of secondary school students regarding topics related to current problems and challenges facing Europe. Critical spots in teaching refer to areas where students frequently struggle or fail to achieve a level of mastery sufficient to foster productive and creative engagement to develop (de Guzman et al., 2017). Common errors (e.g., incorrect test responses) are considered to reflect insufficient or missing knowledge, indicating potential critical spots in teaching; in our study, these occurred with a frequency below 55%. Misconceptions are frequent, deeply rooted, inaccurate, or incomplete ideas or beliefs that deviate from scientifically accepted or pedagogically preferred understandings of a given concept (Vosniadou, 2020); in our study, these occurred with a frequency above 55%. We pose the research question: What are the critical spots and misconceptions in students' understanding of problems and challenges in Europe? We assumed that the research would confirm misconceptions already anticipated by experts while also revealing previously underexplored critical areas where students lack sufficient knowledge. There are several diagnostic tools for identifying mental models and misconceptions in students, the main ones being interviews, analysis of answers to open-ended questions, multiple-choice tests, and multi-layered tests (Kaltakci Gurel, Eryilmaz, & McDermott, 2015). Each tool has distinct strengths and limitations. However, it should be noted that misconceptions are difficult to measure, as we often cannot be sure whether we are measuring true beliefs or rather context-dependent judgments shaped by the testing process (Flynn, Nyhan & Reifler, 2017). A disadvantage of didactic multiple-choice tests is that they cannot distinguish correct answers due to correct reasoning from those due to incorrect reasoning (Caleon & Subramaniam, 2010), so they can overestimate students' scores, the so-called “false positive” and “false negative” concepts (Hestenes & Wells, 1992). Taking these limitations into account, after considering several aspects of testing, we selected a combined didactic test as our research instrument, comprising both open-ended and closed-ended questions as designed. In this study, a didactic test is understood as a standardized assessment tool consisting of identical tasks for all respondents, designed and evaluated according to predefined rules to measure students' knowledge and skills in a specific subject area and to identify critical spots and misconceptions (Blândul, 2009).

From the perspective of empirical quantitative research in the educational sciences (Johnson & Christensen, 2010), our research falls under the category of non-experimental research, in which the researcher does not have the opportunity to control independent variables or implement random selection. We chose testing as the primary research method. Through 14 test items, we examined how students understand selected concepts, processes and contexts within 14 complex topics related to current problems and challenges in Europe. The selected topics are related to the socio-economic area (aging population, urban growth, migration, peripheral regions, multicultural society), the political-geographical area (separatism, perception of democracy, military conflicts) and the environmental area (environmental problems, climate change, energy resources, land depletion, shortage and quality of drinking water). Several of the topics can be classified into multiple areas based on the perspective from which they are viewed (e.g., energy resources, migration, quality of life of residents, etc.). The selection of relevant topics from the perspectives of teachers and students was carried out in a previous questionnaire survey of 412 respondents in Slovakia and the Czech Republic (Škodová, Madleňák, & Damek, 2022). We recognize that the scope of our findings is inherently constrained by the selected themes and questionnaire items, and that students may possess additional misconceptions not captured within the present study. Drawing on an extensive review of the relevant literature, our professional experience, and the aforementioned prior research, only a representative subset of potential misconceptions was included in the empirical verification.

The presented study was created in three main phases (Fig. 1). First, the most frequent misconceptions of students within the addressed (above-mentioned) topics were selected and specified. The selection was based on a literature review and own pedagogical experience. This was followed by research verifying the occurrence of critical spots and misconceptions in selected topics. The next step was therefore the creation and verification of a pilot test. Its optimization was subsequently used to create a final paper didactic test (the full text of the test can be found in the Appendix). The test structure consisted of, in addition to items aimed at obtaining sociometric data (regarding the age and gender of students), 14 open and closed questions designed by the students themselves (with several sub-questions). Expected misconceptions were defined in advance for individual questions. Misconceptions also arise from the fact that students are unable to relate concepts to one another. Therefore, some questions (no. 2-3) were also focused on this aspect.

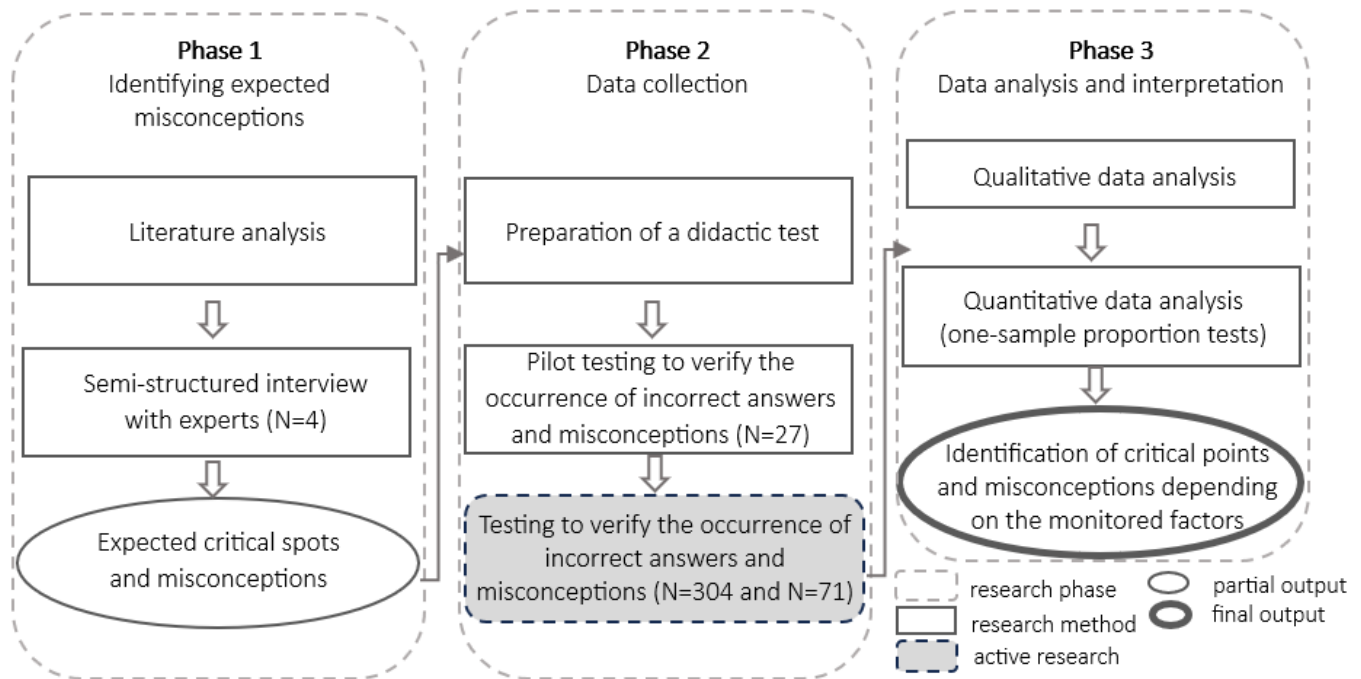


Figure 1. Methodological framework for identifying critical spots and misconceptions in selected topics of European regional geography. Source: Own elaboration.

The central subject of our research was a student attending a Slovak general secondary school (preparing for higher education) who had already completed the thematic unit Regional Geography of Europe as part of the geography course. The total research sample consisted of 304 students (192 female and 112 male), aged 17 – 20 years. Students who participated in the research were from six secondary schools in the Bratislava, Banská Bystrica, and Liptovský Mikuláš regions. The criterion for selecting respondents was based on convenience sampling.

The information obtained through the didactic test was analyzed and evaluated on a qualitative and quantitative level. Descriptive and inferential statistical methods were used to quantify the results. We analyzed the data using RStudio computing software (R Core Team, 2021) and the R programming language (Posit team, 2025). For statistical evaluation, the respondents' answers to the didactic test were systematically coded, with each answer evaluated as either a correct answer, an expected misconception, or other incorrect answers (standard errors). The share of correct answers represents the success rate in a given item. A low success rate for the entire test question indicates a potentially critical point in a particular topic. We also monitored the share of unanswered questions and the influence of gender on the success rate of respondents. According to Hestenes and Wells (1992), we understood a misconception as anticipated incorrect answers occurring with high frequency (more than 55%). However, we also analyzed expected misconceptions with a medium frequency (30-55%). In order to compare the observed success rates of a test item with the expected misconception with the theoretical value, i.e., 55%, and to detect misconceptions, we used one-sample share (z-)tests:

- H0: The proportion of incorrect answers is $\leq 55\%$,
- H1: The proportion of incorrect answers is $> 55\%$.

Because it is challenging to distinguish students' misconceptions from common mistakes, we selected from the set of respondents those whose success rate in testing was higher than 80%. This selected set of respondents consisted of 71 students (38 female and 33 male). For the results of this subgroup, we processed the same analyses as for the entire research sample. We compared and interpreted the results of both samples in the form of tables and graphs.

4. Results

Research results are presented through the analysis and evaluation of data from student testing, which assesses the occurrence of critical spots and misconceptions within geographical topics related to current problems and challenges in Europe.

4.1. Critical spots in topics about current issues and challenges in Europe

The first partial objective of the research was to identify critical spots in the knowledge of secondary school students regarding current issues and challenges in Europe after completing the thematic unit on the regional geography of Europe. The overall average success rate of students in the test was 67.8% (female: 66.8%; male: 68.8%). A more detailed analysis revealed several notable patterns. Students achieved slightly higher success rates in environmental topics (72.3%) compared to socio-economic topics (65.7%) and political-geographical topics (64.6%). The low success rate in addressing tasks related to these areas indicates potential critical spots. In the area of socio-economic topics, students were least successful in understanding the process of population aging (Q4 – success rate 60.6%; the full text of the questions and sub-questions can be found in the Appendix). In the area of political-geographical topics were particularly challenging questions were those related to understanding separatism (Q6 – success rate: 60%) and democracy in Europe (Q11 – success rate: 62.3%). Other problematic items were associated with

insufficient knowledge, such as failing to associate permafrost with Northern Europe, failing to recognize the relationship between floods and soil degradation or between precipitation levels and water quality, and failing to classify Bosnia and Herzegovina as a country with a significant Muslim population. The lowest success rate was observed for question no. 5, which addressed peripheral regions. However, this low performance may also reflect the fact that it was an open-ended question. The questions in which the students were most successful were related to the quality of life in Europe (Q1 – success rate: 94.4%), urban growth (Q9 – success rate: 85.4%) and energy sources in Europe (Q7 – success rate: 84.3%). We also examined whether there were differences in the success rate of boys and girls. Boys were slightly more successful in 64.3% of the questions. The most significant differences, based on gender, were observed in the perception of separatism (Q6, with a 9.2% higher success rate for boys). This difference was particularly pronounced also in distinguishing the causes and consequences of environmental problems in Europe (Q2, with a 5.1% higher success rate for boys). However, the differences found were not statistically significant.

4.2. Misconceptions in topics about current issues and challenges in Europe

The second partial objective of the research was to identify misconceptions in the knowledge of secondary school students about current problems and challenges in Europe after completing the thematic unit on Europe. As misconceptions, we marked those expected (and newly discovered) misunderstandings that occur in a significant percentage of students. The identified expected and unexpected misconceptions with a frequency of occurrence above 55% in the entire group of respondents concerned six of the fourteen topics addressed (Tab. 1). We revealed a total of 6 misconceptions – 3 misconceptions in the area of socio-economic topics (average 67.5% occurrence), 1 misconception in the area of political-geographical topics (average 64.7% occurrence) and 2 misconceptions in the area of environmental topics (average 63% occurrence).

Table 1. One-sample proportion (z)-test results for the full respondent sample (N = 304).

Expected misconception	p-value	Expected misconception	p-value	Expected misconception	p-value
2.e	1.00000	7.g	1.00000	12.a	0.00000
3.ch*	0.00004	7.h	0.00000	13.a	1.00000
4.b	1.00000	8.h	1.00000	13.b	1.00000
4.f	1.00000	9.c	1.00000	13.c	1.00000
4.g	0.01304	9.d	1.00000	14.a	1.00000
4.h	0.99780	10.b	0.99995	14.b	1.00000
4.ch	1.00000	11.a	0.00000	14.c	1.00000
6.b	1.00000	11.b	0.31004	14.e	0.00001
6.e	0.99780	11.d	1.00000	14.f	1.00000
6.g	1.00000	11.e	1.00000		

Source: Own elaboration based on statistical analysis.

Note: *Revealed misconceptions are highlighted in bold. The full text of questions and sub-questions 2.e-6.g can be found in the Appendix.

For the full research sample of respondents (N = 304), the null hypothesis is rejected at the 5% significance level, supporting the assertion that the following misconceptions occur in seven sub-questions: 3.ch, 4.g, 7.h, 11.a, 11.b, 12.a, 14.e (in the Appendix):

- 89.1% of respondents did not recognize Russia as a country with a relatively high proportion of Muslims (e.g., compared to Germany and the United Kingdom). Russia does not record official statistics on the religious affiliation of its citizens. According to Pew Research Center data (Hackett et al., 2025), in 2020 the share of Muslims in Russia was 8.2%, while in Germany it was 6.5% and in the United Kingdom it was 6.4%. The identified misconception among students may be influenced by geographical and historical education in Slovakia, which often emphasizes the idea of Russia as the largest Slavic state with an Orthodox population. Less attention is paid to the country's genuine ethnic and religious diversity. Another explanation is geopolitical narratives that are very intensively disseminated in Slovakia by numerous pro-Kremlin propaganda channels (e.g., pro-Russian websites and actors on social networks or a significant part of the political representation). During the migration crisis, these actors portrayed Western Europe as a space flooded with Muslim migrants and facing a real threat of Islamization. They also contrasted their sharp criticism of the EU's migration policy with the idea of a stable Slavic-Christian Russia under the sensible leadership of President Putin, the guardian of traditional Christian values in Europe. (SQ 12.a)
- 71.7% of respondents believed that Switzerland has the highest level of democracy in Europe. Switzerland ranks high in the Democracy Index compiled by The Economist, but the countries of Northern Europe rank even higher. This is especially true of Norway, which regularly ranks first in the ranking, but does not resonate with democracy as much as Switzerland among students. This misconception may relate to the perception that Switzerland's direct democratic mechanisms are "more democratic" than representative systems (Donovan & Karp, 2006). Narratives about the democratic deficit of representative democracy and the perceived need to implement elements of direct democracy, following the Swiss model, are frequently advanced by populist political parties (Mohrenberg et al. 2021; Angelucci et al., 2024). (SQ 11.a)
- 67.6% of respondents perceived nuclear energy production as highly environmentally unfriendly compared to other energy sources. This view may be influenced by awareness of major nuclear accidents (e.g., Chernobyl and Fukushima), which raises safety concerns

and leads students to regard nuclear energy as too risky to be ecologically acceptable. Furthermore, the rise in alternative energy sources may contribute to the perception that these options are more environmentally friendly than nuclear energy. (SQ 7.h)

- 65.6% of students believed that the Russian Federation is among the five largest economies globally by GDP. According to IMF and World Bank data, Russia currently ranks 11th. This overestimation may result from students' perception of Russia's vast territory and natural resources, as well as geopolitical narratives portraying Russia as a global power, which may inflate perceptions of its economic importance. (SQ 14.e)
- 58.3% of students considered the Mediterranean the most threatened region in Europe regarding sea level rise, whereas Northern European regions are more affected. This misconception may be influenced by media coverage focusing on Mediterranean areas due to dense population and high tourist activity. (SQ 3.ch)
- 57.9% of respondents believed that the populations of Southern European countries age more slowly than those of Northern Europe. This misconception likely stems from stereotypical views of Southern Europeans as traditional and family-oriented, associated with higher birth rates. However, some Southern European regions with lower urbanization levels (e.g., Italy, Greece, France, Bulgaria) are currently among the most rapidly aging in Europe. (SQ 4.g)

The overall results of the didactic test are summarized in a graph (Fig. 2), depicting the proportion of incorrect answers, the proportion of incorrect answers corresponding to expected misconceptions, and the confirmed misconceptions (with a frequency exceeding 55%), organized by topic in the regional geography of Europe.

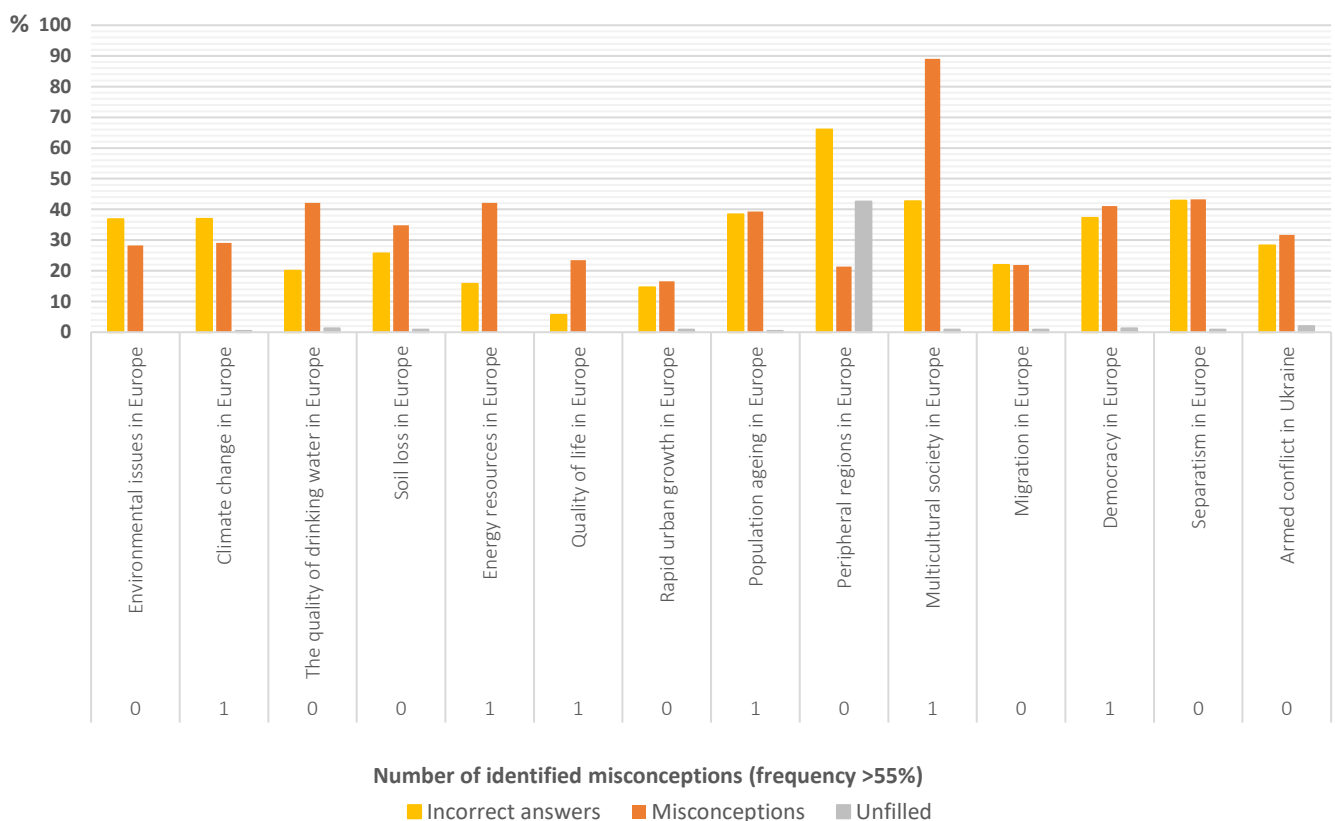


Figure 2. Proportion of incorrect answers, proportion within expected misconceptions, proportion of unfilled answers, and number of identified misconceptions in student testing. Source: Own elaboration. Note: Incorrect answers – incorrect responses (common errors) with a frequency below 55%; Misconceptions – incorrect answers and expected misconceptions with a frequency above 55%; Unfilled – unfilled sub-questions; Number of identified misconceptions – absolute number of identified misconceptions in the evaluated topics.

A detailed view of misconceptions is provided by analyzing the results of students with a test success rate of more than 80%. In this group, we detected three misconceptions (Table 2). For this sample of respondents (N = 71), we reject the null hypothesis at the 5% significance level, and therefore support the claim that the following misconceptions are present in the following two sub-questions: 11.a and 12.a (in the Appendix):

- 87.6% of students with a test score of more than 80% do not perceive Russia as a country with a relatively high proportion of Muslims (e.g., compared to Germany, the United Kingdom, etc. (SQ 12.a)
- 76.3% of students with a test score of more than 80% think that Switzerland (and not the countries of Northern Europe) has the highest level of democracy in Europe. (SQ 11.a)

At the 10% significance level, sub-question 4.g also appears to indicate a misconception:

- 56.3% of students with a test score higher than 80% think that the population of Southern European countries is “aging” less than that of Northern European countries. (SQ 4.g)

In this subgroup of respondents, incorrect answers in sub-questions 7.h, 14.e, and 3.ch occurred with a frequency of less than 55%. Therefore, they can be considered to reflect insufficient knowledge, even in the total set of respondents.

Table 2. One-sample proportion (z-)test results for the high-performing respondent subgroup (N = 71).

Expected misconception	p-value	Expected misconception	p-value	Expected misconception	p-value
2.e	1.00000	7.g	1.00000	12.a	0.00000
3.ch	0.54900	7.h	0.45700	13.a	1.00000
4.b	0.99700	8.h	1.00000	13.b	1.00000
4.f	1.00000	9.c	1.00000	13.c	1.00000
4.g*	0.09700	9.d	1.00000	14.a	1.00000
4.h	0.86100	10.b	0.99400	14.b	1.00000
4.ch	1.00000	11.a	0.00000	14.c	1.00000
6.b	1.00000	11.b	0.99700	14.e	0.80100
6.e	0.99700	11.d	1.00000	14.f	1.00000
6.g	1.00000	11.e	1.00000		

Source: Own elaboration based on statistical analysis.

Note: *Revealed misconceptions are highlighted in bold. The full text of questions and sub-questions 2.e-6.g can be found in the Appendix.

5. Conclusions and Discussion

Geography, as a “science of sustainability,” plays a crucial role in shaping students’ ability to interpret the complexities of local and global challenges. Our findings confirm previous research (Levinson & Turner, 2001; Jeong et al., 2021) that the inclusion of socially relevant and cognitively demanding topics in education is necessary for fostering critical thinking, argumentation skills, and the ability to work with diverse sources of information. At the same time, the present study demonstrates that such complex content also carries a heightened risk of misconceptions. Students’ conceptual understandings are shaped not only by school instruction but also by family, media, and peer environments. This highlights the need for geography education to function not merely as a transmitter of facts, but as a corrective and interpretive framework (Lane, 2015), systematically addressing common misconceptions and equipping learners with tools for critical evaluation.

The objective of this study was to examine critical spots and misconceptions in students’ understanding of problems and challenges in Europe. Our research confirmed several critical spots and misconceptions in the knowledge of secondary school students in Slovakia. Four key findings can be highlighted and discussed:

- 1. Students achieved better results in environmental topics than in political or socio-economic geography.** This supports earlier findings (Tippett & Milford, 2017; Schoeman, 2015) that abstract socio-political topics are perceived as less clear, cognitively more demanding, and often avoided in school practice due to their controversial nature. Our results therefore underscore the importance of strengthening the political dimension of geography education, not only to bridge knowledge gaps but also to prepare young citizens to engage with pressing democratic and geopolitical questions. From a curricular perspective, this implies that political geography should not remain marginal but should be explicitly framed as part of citizenship education and global competence development.
- 2. The analysis revealed six core misconceptions as well as a broader set of erroneous ideas across political, socio-economic, and environmental domains.** Some of these misconceptions – such as misunderstandings about nuclear energy, democracy rankings, or the demographic structure of Europe – have also been documented in previous studies (Gökmen et al., 2010; Gusev, 2014; Zucchetti et al., 2021; Kuzio, 2015). These misconceptions are not trivial errors: they can shape political attitudes, perceptions of legitimacy, and long-term orientations toward democracy and sustainability (Alesina, Miano & Stantcheva, 2022; Rodriguez-Justicia & Theilen, 2022; Ruhs, Tamas & Palme, 2019). In this sense, geography education contributes not only to disciplinary understanding but also to democratic resilience, as correcting misconceptions is directly linked to fostering critical citizenship.
- 3. The observed correlations between certain items (e.g., between attitudes toward democracy, illegal immigration, and geopolitical issues) suggest that misconceptions and knowledge gaps are not isolated phenomena but are interconnected.** This points to the systemic nature of student thinking: misconceptions in one domain (such as migration, see Lutz & Bitschnau, 2023) can reinforce or legitimize misperceptions in another (such as democracy or geopolitics). Such interlinkages highlight the need for integrated, interdisciplinary approaches in teaching, where geography serves as a bridging subject capable of contextualizing diverse social, political, and environmental dimensions (Yaar-Waisel & Leininger-Frézal, 2025).
- 4. The results of the study indicate that several misconceptions persist even among the most successful secondary school students.** We therefore argue that these topics and their critical spots need to be addressed to a much greater extent than is currently the case. We concur that geography education cannot be limited merely to the transmission of facts but must actively engage students in critical reflection and discussion (Bryan & Tippett, 2006).

The study is based on the simplifying assumption that phenomena can be observed directly and objectively, and that students’ conceptions can be categorized as either correct or incorrect. Although such an approach was necessary for us, it inevitably entails certain limitations. In human geography, it is often not possible to draw a clear boundary between correct and incorrect interpretations, as what is regarded as “true” frequently depends on the context and the perspective from which societal phenomena and processes are examined. We therefore consider it essential, when assessing students’ views, to engage in discussion of these differing perspectives and to provide appropriate examples and relevant data. The insights gained into students’ knowledge and misconceptions have informed the development of an interactive textbook (Madleňák et al., 2025) that not only conveys objective information but also fosters critical reflection and encourages discussion of the most pressing problems and challenges facing Europe.

5.1. Limitations and Future Research Directions

Although this study provides valuable insights into misconceptions in selected topics of regional geography of Europe, several limitations should be acknowledged. First, the research was conducted using a convenience sample of 304 secondary school students from six secondary schools in Slovakia. Consequently, the findings cannot be generalized to the broader population, and any inferential statistics, including p-values and correlation tests, should be interpreted with caution. While p-values are reported to indicate potential associations, the assumptions underlying inferential statistics are not fully met in this context. Their inclusion is intended solely to provide exploratory insights rather than confirmatory evidence (Hirschauer et al., 2020). Finally, the scope of the study focused on a subset of topics in European geography, and other relevant areas might reveal additional misconceptions or critical spots not captured in this survey.

Despite these limitations, the study opens several avenues for further investigation. Future research could explore the genesis of misconceptions through interviews with students or by gathering teachers' perspectives on the most critical spots in the curriculum. Partial results from this study will inform the development of a three-stage test for a larger and more representative sample of respondents. Moreover, future studies could examine the effectiveness of targeted didactic interventions in reducing misconceptions and enhancing critical thinking, argumentation skills, and the ability to evaluate contested information in social and environmental contexts.

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Appendix

Test: Assessment of Students' Knowledge of Problems and Challenges in Europe

Student age: School / Study program: Date: Sex M/F:

- Circle five European countries that, in your opinion, offer the best **living conditions**. Consider factors such as purchasing power, safety, healthcare quality, affordability, climate, environmental quality, freedom, and political stability.

Netherlands, Bulgaria, Ukraine, Slovakia, Spain, Finland, Austria, Serbia, Belarus, Germany

- Fill in the table with the causes and possible solutions to **environmental problems** in Europe. Use the letters from the box (use each letter only once):

- A. Deforestation and unsustainable land use in forests and agricultural fields
- B. Improved technologies, waste separation, and reduction of consumption
- C. Appropriate land use
- D. Changes in land use
- E. Energy production from fossil fuels (coal, oil, gas)
- F. Industry, transport, agriculture
- G. Active protection of habitats and species
- H. Use of renewable energy sources

MOST SIGNIFICANT CAUSE	ENVIRONMENTAL PROBLEM	EXAMPLE OF SOLUTION
	<ul style="list-style-type: none"> • Climate change 	
	<ul style="list-style-type: none"> • Pollution of all environmental components 	
	<ul style="list-style-type: none"> • Floods 	
	<ul style="list-style-type: none"> • Extinction of plant and animal species 	

- Complete the table with the current or potential consequences of **climate change** for regions of Europe. Use letters from the options provided (use each letter only once):

- A) Drought, B) Permafrost melting, C) Increased precipitation, D) Negative impact on tourism, E) Loss of biodiversity, F) Extreme heatwaves, G) Melting of continental and mountain glaciers, H) Changes in vegetation zones, CH) Flooding of low-lying areas, I) Increased risk of wildfires, J) Water shortage in glacier-fed river basins, K) Melting of mountain glaciers

REGION	MEDITERRANEAN	NORTHERN EUROPE	MOUNTAINOUS AREAS OF EUROPE
CONSEQUENCES OF CLIMATE CHANGE			

4. One of the problems Europe has been facing in recent years is **population aging**. Circle **T** for statements you believe are true, or **F** for statements you believe are false:

- a) Europe’s population is aging because its inhabitants are also naturally getting older. T/F
- b) Migration affects the aging of Europe’s population. T/F
- c) The increase in average life expectancy affects the aging of Europe’s population. T/F
- d) Low birth rates affect the aging of Europe’s population. T/F
- e) The aging of Europe’s population is caused by the retirement of the baby-boom generation after World War II T/F
- f) Urban populations are aging more significantly than rural populations. T/F
- g) The populations of Southern European countries with a high proportion of traditional families (e.g., Greece, Italy, Spain) are aging less than those of Northern European countries with a higher degree of liberalism (e.g., Sweden, Denmark). T/F
- h) The populations of Western European countries (e.g., Switzerland, Belgium, Austria) with a higher degree of individualism are aging more than post-socialist countries of Eastern Europe (e.g., Bulgaria, Romania, Baltic States). T/F
- ch) The aging of Europe’s population does not affect people of working age. T/F

5. Explain the term “**peripheral region**” in one or two sentences.

.....

.....

6. Circle examples of **separatism** in Europe:

- a) The independence of Kosovo from Serbia
- b) The dissolution of Yugoslavia and the creation of Bosnia and Herzegovina
- c) Catalonia’s attempt to gain independence
- d) The secession of Transnistria from Moldova
- e) The annexation of Crimea in 2014
- f) Scotland’s attempt to gain independence
- g) The dissolution of Czechoslovakia and the creation of Slovakia

7. Circle one or more **electricity sources** in Europe that you consider environmentally friendly:

- a) Solar energy
- b) Geothermal energy
- c) Coal combustion
- d) Wind energy
- e) Hydropower
- f) Gas and oil combustion
- g) Biomass combustion
- h) Nuclear energy

8. Circle one or more causes of loss and decreasing **quality of arable land** in Europe:

- a) Acid rain
- b) Expansion of residential, storage, commercial areas, and transport infrastructure
- c) Division of arable land into small plots
- d) Intensive chemical use in agriculture (fertilizers, herbicides, pesticides)
- e) Focus on organic food production
- f) Overpopulation of wildlife in forests
- g) Flooding of land during floods
- h) EU agricultural policy

- ch) Expansion of forested areas
- i) EU migration-friendly policy

9. Circle one or more correct options. **Large cities in Europe grow rapidly** because:

- a) They offer a higher quality of life
- b) They provide affordable housing and services
- c) People do not feel lonely
- d) There is targeted EU policy behind it
- e) They provide quality healthcare
- f) They offer sufficient employment opportunities

10. Circle one or more correct options. Factors influencing the **quality of drinking water** in Europe include:

- a) Increasing sales of carbonated sugary drinks
- b) Amount of atmospheric precipitation
- c) Geological substrate
- d) Bottling of drinking water

11. There are countries in Europe with different **levels of democracy**. According to the so-called Democracy Index, which measures the level of democracy, Europe is home not only to some of the most democratic countries in the world, but also to countries that cannot in any way be considered democratic. Circle **T** for statements you believe are true, or **F** for statements you believe are false:

- a) Switzerland has the highest level of democracy in Europe T/F
- b) The level of democracy in a country is influenced by whether it is a monarchy or a republic T/F
- c) Democracies are not inclined to solve problems through war T/F
- d) Autocracies can fight corruption more successfully than democratic states T/F
- e) Russia is a more democratic country than Ukraine T/F
- f) Democracies have better tools to mitigate political tension in society T/F

12. From the European countries listed below, circle the three with the highest **proportion of Muslims**:

Russia, Germany, Italy, Spain, Bosnia and Herzegovina, United Kingdom, Albania

13. Circle the correct answer in the second or third column of the table for the questions in the first column:

a) According to international law, is a person fleeing war or persecution considered an illegal migrant?	Yes	No
b) Which poses a greater threat to a country's economy?	Emigration	Immigration
c) Where do people have a more negative attitude toward immigrants?	In countries with many immigrants (e.g., Sweden, Germany, Ireland)	In countries with almost no immigrants (e.g., Slovakia, Czechia, Hungary)

14. Circle **T** for statements you believe are true, or **F** for statements you believe are false:

- a) The 2014 referendum in Crimea, in which residents voted to secede from Ukraine and join Russia, is considered legitimate under international law. T/F
- b) Russian-speaking residents of Ukraine can automatically be considered Russians. T/F
- c) Ukraine does not have internationally recognized state borders. T/F
- d) Russia's military invasion of Ukraine in February 2022 continues the aggression that began with the occupation of Crimea in 2014. T/F
- e) The Russian Federation is among the five largest economies in the world by GDP (according to data from the World Bank and the International Monetary Fund). T/F
- f) According to the Corruption Perceptions Index, corruption is higher in Ukraine than in Russia. T/F

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