# Level of pupils´ map skills in Slovakia

Michael FUCHS, Elena ČIPKOVÁ, Štefan KAROLČÍK,
Kristína HUSZÁROVÁ, Jana PČOLOVÁ

***Abstract:*** *The aim of geographical education is to enhance the level of geographical literacy among pupils, enabling them to acquire, comprehend, analyse, and interpret geographic information so they are able to apply it effectively. One approach to improving this literacy level involves utilizing map skills, through which pupils can read, analyse, interpret map content, and even create maps. This research aimed to assess the level of selected map skills among Slovak pupils at the end of lower secondary education (ISCED 2). A self-constructed research tool was used as the research instrument. Analysis of the acquired data revealed an average level of map skills among the pupils. The highest proficiency was observed in tasks focused on utilizing skills associated with map reading. Conversely, the lowest proficiency was found in tasks requiring the application of skills related to map analysis. The data collected suggest that although pupils at the end of lower secondary education possess skills enabling them to obtain necessary information from a map, they encounter challenges in analysing and subsequently interpreting this information.*

***Keywords:*** *map skills, geography education, map, pupils*

## Introduction

The rapid technological advancement in recent decades has made maps an inseparable part of everyday human life, as they are readily available on computers, tablets, or smartphones (Fraser, Taylor and Caquard 2006). According to Peterson (2005), searching for information on maps ranks among the most common activities in the virtual environment of the internet. Moreover, maps represent one of the most significant educational tools in teaching geography (Artvinli and Dönmez 2020), providing crucial information about the physical and human geographical characteristics of a region (Khullar 2011). Their significance lies not only in providing information (Lobben 2004) and visually representing a specific geographic space (Dempsey 2003, Havelková and Hanus 2019), they can be used for enhancing spatial (Saputro, Liesnoor and Hardati 2020), analytical and critical thinking (Elbow and Sharma 2000, Giannakou and Klonari 2019), and fostering further creativity in pupils (Saripudin, Ratmaningsih and Anggraini 2022). With the development of digital technologies, maps have become multidimensional, interactive, and dynamic, contributing to increased engagement of pupils when interacting with the information they contain (Osaci-Costache, Cocoş and Cocoş 2014). All these map functions contribute to shaping an educational environment in which pupils are not passive recipients but are stimulated towards deeper analysis and subsequent interpretation of the information provided by maps. Some studies (e.g., Saku 1992, Lateh and Raman 2005, Taylor and Plewe 2006) emphasize that the use of maps in geographic education can contribute to a better understanding of fundamental geographic concepts. If we aim to use maps as a source of information for pupils, it is essential for them to possess a certain level of skills associated with reading, analysing, and interpreting maps (Muehrcke 1981). Many studies (e.g., Grofelnik and Pap 2013, Ooms et al. 2016, Havelková and Hanus 2018, Kumar and

*DOI: https://doi.org/10.33542/GC2024-1-02*

Vakkil 2020, Pravda 2021) point to a relatively low level of map skills among pupils. According to Enright (2021), one reason for this state could be the very nature of geographic education, which comes from the mistaken assumption that a map is merely a source of facts and information to be accepted without further analysis. This simplified perception of working with maps needs to be replaced by a more complex approach, involving the utilization of various knowledge and skills for a complete understanding and usage of the information that maps offer. A map represents an information source encountered in everyday life, making it crucial within education to teach pupils how to work with it correctly (Malik 2015). Thus, the demand for systematic examination and subsequent enhancement of pupils' map skills becomes our priority.

## Map skills

Despite a relatively long period of studying map skills, researchers did not come to an agreement on its clear definition (Carbonell-Carrera and Hess Medler 2017, Yalcinkaya and Karaca 2021). This disagreement is based on the fact that map skills encompass a considerably broad concept, integrating a combination of knowledge and various innate abilities, and skills acquired through training and experience. As a result of this, some authors even prefer to use the term "map literacy" in their papers (Hakan and Demir 2014). In the literature, we also encounter the term cartographic skills (e.g., Grofelnik and Pap 2013, Nazarenko et al. 2021), which, however, needs to be perceived more broadly, as it encompasses skills required for working with other cartographic materials besides just maps. Map skills primarily involve cartography knowledge (Muir 1985, Shin 2006, Gökçe 2015) and abilities such as the capability to read maps (Tyner 2014, Havelková and Hanus 2019, Sarif 2022, Şeyma, Yayla and Zünber 2022), comprehend, interpret, and work with map symbols (Sönmez 2010, Yalcinkaya and Karaca 2021, Sarif 2022), interpret geographical data (Schee and Dijk 1999, Havelková and Hanus 2019), using maps in everyday life and for planning purposes (Blaut 1997, Hemmer et al. 2015, Koç and Önal 2016), spatial orientation and thinking (Şeyma, Yayla and Zünber 2022), map measurement (Sönmez 2010), and map creation (Meyer 1973, Havelková and Hanus 2019). Due to technological advancements and increased accessibility, it is necessary to perceive map skills in the context of utilizing various digital tools, including modern geographic information systems (Shin 2006, Collins 2018). This set of knowledge and abilities enables pupils to acquire necessary information through maps, analyse it, and subsequently interpret it.

The numerous attempts to define map skills have led to the creation of various classifications that differ from each other (Erol 2020). For instance, McClure (1992) outlined within his classification skills related to understanding and interpreting map symbols, map reading, profiling, wayfinding, distance and spatial calculation, slope and position measurement, scale usage, map creation, and characterization of physical properties. On the other hand, Sönmez (2010) categorized map skills into six groups ranging from concrete to abstract skills. These encompass the ability to understand and interpret symbols, read and interpret maps, orient oneself, determine coordinates, use scales, and measure distances on a map. Gradually, common elements among these classifications have emerged (Erol 2020). These involve the skills to read, analyse, and interpret maps, which have been evident in the works of several authors (e.g., McClure 1992, van Dijk et al. 1994, Weeden 1997, Carter 2005, Hanus and Marada 2014, Hanus and Havelková 2019, Sarif 2022). Reyes Nunez (2020) emphasizes that geography education is more than just using maps, reading, and understanding them. Another map skill that has come to the forefront is map creation. Hanus and Havelková (2019) delineate

the division of map skills into two fundamental areas, namely map creation and skills associated with map usage (reading, analysis, and interpretation). These map skills need to be perceived in mutual interaction. For this purpose, a circular model has been devised, highlighting the necessity for comprehensive map utilization in education. Apart from the map skills themselves, pupils also need to possess specific cartographic information, geographical knowledge, and the ability to acquire and process information from various sources (Fig. 1).

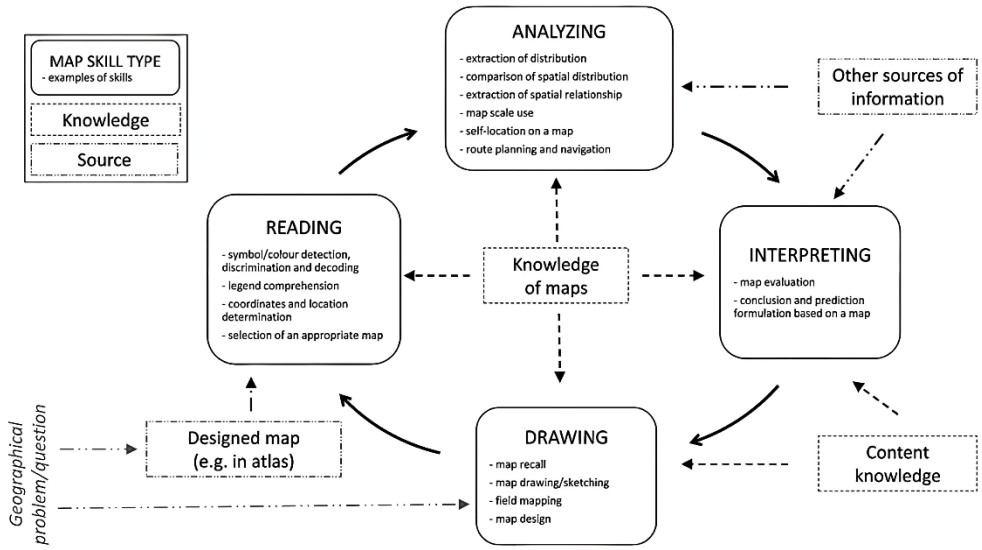


***Fig. 1.*** *The model of map skills (Hanus and Havelková 2019)*

The skills associated with working with maps are recognized as an established part of curricula in developed countries (Ndlwana 1991). However, research findings (e.g., Unlu 2011, Mwenesongole 2009, Mukondeleli 2018, Sarif 2022) indicate that the level of map skills among pupils is inadequate, which may also reflect in a lower level of geographic literacy. The requirement to systematically enhance these skills among pupils at the lower secondary education level (ISCED 2) in Slovakia is ensured through the teaching of geography. Within individual lessons, pupils should have the opportunity to work with maps and acquire new knowledge and skills through their content. Despite lower secondary education in geography being based on the same curriculum throughout Slovakia (ŠPÚ 2014a), differences in the level of map skills among pupils might exist. Essentially, these differences stem from the influence of various internal and external factors, such as school technological resources (Čipková, Fuchs and Šmida 2023), school location (Adepoju and Akinwumi 2001), pupils' gender (Sarif 2022), frequency of map usage in education (Aksoy 2019), school type (Sarif 2022), or the map characteristic (Havelková and Hanus 2018). Havelková and Hanus (2019), based on their analysis of conducted research, categorized these factors into three main categories: user characteristics (e.g., age, gender, ethnicity and culture, acquired knowledge and skills, interests, psychological factors), map characteristics (e.g., map complexity; cartographic means of representation), and external factors (e.g., family, learning style, education, residence, tested map skill).

## Goals and research questions

Within the teaching of geography at the lower secondary education level, pupils are required to grasp various abstract concepts, symbols, and ideas, explain the implications of a specific phenomenon, or describe the interconnections between different elements of the landscape (Bednarz, Acheson and Bednarz 2006). Utilizing a map as a visual tool can assist pupils in transforming these abstract concepts into specific representations, thereby facilitating the entire learning process. To employ a map as an educational tool, pupils must possess a certain level of map skills, primarily focused on reading, analysing, and interpreting maps. These skills also enable pupils to convert various information into graphical representations (Nyoni 2021). The State Educational Program in Geography in Slovakia (ŠPÚ 2014a) advocates for pupils to progressively enhance these skills from the beginning of lower secondary education (ISCED 2). This creates an assumption that pupils at the end of their lower secondary education should already possess developed map skills, enabling them to work with maps not only in school but also in their everyday lives. Therefore, the conducted research aimed to assess the current level of selected map skills among pupils at the end of lower secondary education. In line with this objective, our focus was on addressing the following research questions:

- What is the overall level of selected map skills among pupils?
- What is the level of selected map skills among pupils based on gender, school type, and school location?

## Methodology

According to Havelkova and Hanus (2019), the issue of map skills has been the subject of research for several decades. Nevertheless, there is still no universally available research tool to assess the current level of these skills among educated pupils. Currently, in available literature, several techniques and approaches are known to examine individual map skills among pupils. Authors often utilize various types of tests with open or closed-ended tasks (e.g., Mrázková and Hofmann 2011, Grofelnik and Pap 2013, Albert et al. 2016, Sarif 2022), models (e.g., Hart 1979), field testing (e.g., Kastens, Kaplan and Christie-Blick 2001, Meilinger and Knauff 2008), virtual map tests (e.g., Hsu, Tsai and Chen 2018), creating personalised maps (e.g., Wigglesivorth 2003), or tasks related to field mapping (Kastens and Liben 2007). To determine the level of selected map skills among pupils, we chose to employ a test of our own design. Specifically, we focused on skills related to reading, analysing, and interpreting maps. In its development, we drew from the requirements of the State Educational Program in Geography (ŠPÚ 2014a), as well as the publication by Hanus et al. (2020), which introduced a methodological approach aimed at creating tasks that allow the application of map skills in geography teaching.

The created test consisted of 24 closed items, offering a choice of one correct answer from five available options (Fig. 2). Such a test design diminishes the subjective role of the evaluator (Čipková and Fuchs 2020). The number of items was suggested to align with the possibilities and capabilities of the pupils. The skill of map reading as well as map analysis was tested through nine items, and the skill of map interpretation was allocated six items. Each item of the administered test was accompanied by various types of maps encountered within the lower secondary education curriculum. The request to administer our developed research tool in electronic form was sent to all schools in Slovakia providing lower secondary education. Geography teachers could then provide access to their ninth-grade primary school pupils or the fourth-grade pupils of eight-year grammar schools The actual provision of the research tool to pupils was contingent upon geography teachers' interest in participating in the research. Methodologically, we employed an available participant selection method, enabling the relatively swift acquisition of necessary data for analysis from the highest possible number of respondents in a relatively short time (Lopez and Whitehead 2013). Pupils were allocated 45 minutes to complete the test. Upon completion and submission of the test, pupils received feedback in the form of an overall score and the correct answers to individual test items. Each correct response in the test was rated one point.

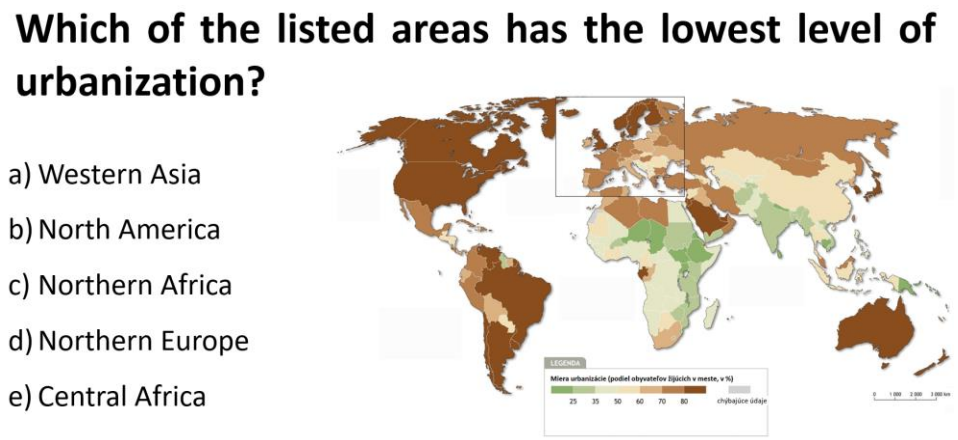


***Fig. 2.*** *Sample test item*

Before starting the research, content validity of the test was assessed by four experts in the field of geography education (Heale and Twycross 2015). Based on their recommendations, we modified the wording of certain items. The test was also made available to a selected group of six pupils to determine the comprehensibility of individual items among the target group of pupils. Some items were slightly adjusted based on their feedback as well. Test reliability was established using the Kuder-Richardson Formula 20 (KR20), suitable for investigating dichotomous items (Ntumi, Agbenyo and Bulala 2023). Its value reached 0.82, indicating a reliable research tool (Nunnally and Bernstein 1978). The average item discrimination index score was at 0.64, with as many as 21 items achieving an excellent discrimination level. The average item difficulty value stood at 57.42. The difficulty and sensitivity index values for individual test items are presented in *Figure 3*.

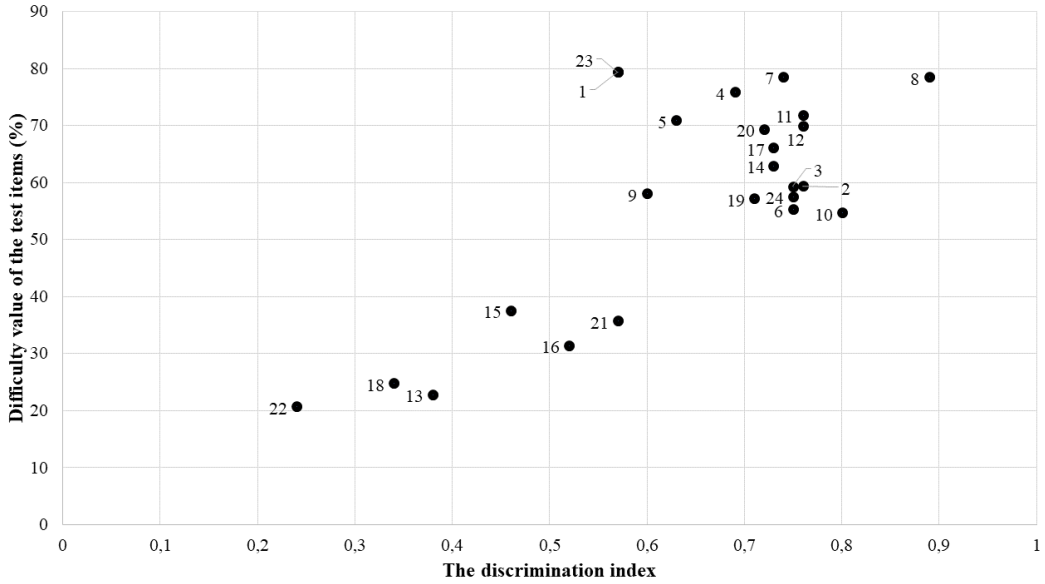


***Fig. 3.*** *The discrimination index and the difficulty value of the items*

## Research sample

In the research, 1209 pupils from the final year of lower secondary education (ISCED 2) participated. Lower secondary education in Slovakia is provided by general primary schools and eight-year grammar schools. Eight-year grammar schools represent a specific type of selective school intended for only 5% of pupils from the respective age cohort. Typically, pupils continue their education at the same school after completing lower secondary education at grammar schools, while pupils from general primary schools proceed to secondary schools. The mandatory curriculum framework establishing the educational content is the same for primary schools and eight-year grammar schools, as it follows the requirements of the same National Curriculum (ŠPÚ 2014a). However, research conducted across various subjects, including geography, suggests that differences may exist among these pupils, for example, in terms of knowledge (e.g., Hornáčková 2006, Kurajová Stopková and Kuraj 2006, Prokop, Kvasničák and Pištová 2006) or various types of skills (e.g., Čtrnáctová et al. 2013, Řezníčková et al. 2013, Rokos and Vomáčková 2017). The average grade in geography on the report card of the pupils involved in the study was 1.58. This assessment should also encompass the level of map skills among the pupils. Further details regarding the demographic structure of the research sample are provided in *Table 1*.

***Tab. 1.*** *Participants´ demographic data*

| **Gender** | | Male | Female |
|---|---|---|---|
| | n | 582 | 627 |
| | % | 48,14 | 51,86 |
| **Type of school** | | Primary school | eight-year grammar schools |
| | n | 1039 | 170 |
| | % | 85,94 | 14,06 |
| **School location** | | City | Countryside |
| | n | 642 | 567 |
| | % | 53,10 | 46,9 |

Despite having the same educational standards (ŠPÚ 2014a), differences might exist among schools within regions, such as variations in technical resources or the qualifications of teachers, which can reflect in regional disparities in pupils' educational outcomes (Adepoju and Akinwumi 2001, Čipková, Fuchs and Šmida 2023).

## Data analysis

In analysing the obtained data, apart from descriptive statistics (e.g., mean, median, mode, standard deviation etc.), we focused on determining whether there were statistically significant differences in pupils' map skills concerning gender, type of school attended, and its location. When analysing data from a large research sample ($n > 50$), we can overlook data distribution (Altman and Bland 1995, Elliott and Woodward 2007). This implies that we can apply parametric tests even if the normality test result indicates that the data doesn't follow a normal distribution (Pallant 2020). Therefore, to identify possible statistically significant differences, we employed the parametric Student's t-test, which compares means between two samples (Mishra et al. 2019). The effect size of statistically significant differences was determined using Cohen's *d* coefficient, which describes the standardized mean difference effect between two groups (Fritz, Morris and Richler 2012).

## Research findings

### *The overall level of pupils' map skills*

In the administered map skills test, pupils achieved an average score of 13.46 points (SD = 5.57) out of a maximum of 24 points. The overall success rate in the test thus stood at 56.08%. The median reached a value of 14.5, and the mode was 18 points.

Based on the analysis of individual tested map skills (Tab. 2), it can be noted that pupils achieved the highest success rate in map reading (I = 70.02%). Across four items in this skill, pupils achieved the overall highest success (items 1, 7, 8, 4). These items required pupils to identify necessary information based on the provided map legend. The lowest success rate within map reading was observed in items 2 and 9, where pupils were tasked with reading specific geographical coordinates on the map.

***Tab. 2.*** *The average success rate of the pupils in the test*

| Skills | Item | The success rate for an item [%] | The success rate for a skills [%] |
|---|---|---|---|
| Reading a map | 1 | 79,49 | 70,02 |
| | 2 | 59,47 | |
| | 3 | 62,37 | |
| | 4 | 75,93 | |
| | 5 | 70,97 | |
| | 6 | 68,24 | |
| | 7 | 78,66 | |
| | 8 | 78,58 | |
| | 9 | 58,15 | |
| Analysing a map | 10 | 61,46 | 49,90 |
| | 11 | 71,96 | |
| | 12 | 69,98 | |
| | 13 | 22,91 | |
| | 14 | 63,03 | |
| | 15 | 37,63 | |
| | 16 | 31,51 | |
| | 17 | 66,17 | |
| | 18 | 24,90 | |
| Interpreting a map | 19 | 57,24 | 44,20 |
| | 20 | 69,48 | |
| | 21 | 35,81 | |
| | 22 | 20,76 | |
| | 23 | 24,90 | |
| | 24 | 57,65 | |

The pupils achieved the lowest average percentage success compared to the overall test percentage success in skills related to map analysis and interpretation (Tab. 3). The percentage success in the skill of map interpretation was at 44.20%, and in three items (items No. 22, 23, 23), the pupils achieved significantly lower percentage success compared to the overall test success. In these items, pupils were required to draw conclusions about a specific geographic space based on the provided map. In the skill of map analysis (I = 49.9%), pupils attained the lowest success in items No. 13, 18, and 16, where they were to compare the spatial distribution of phenomena on the map.

***The level of map skills among pupils based on gender***

Within the analysis, we focused on determining whether there were statistically significant differences in the level of investigated map skills among pupils based on gender. We found that girls (x = 13.17; SD = 5.53) and boys (x = 13.78; SD 5.6) achieved comparable scores on the test. However, the result of the Student´s t-test (t = 1.933; p = 0.043) demonstrated statistically significant differences favoring boys compared with the girls´ results. Nonetheless, the Cohen's *d* coefficient reached a value of 0.11, indicating only a small effect size. We followed a similar approach in comparing individual map skills (Tab. 3). Boys achieved a higher percentage success in skills related to map reading and analysis. On the contrary, girls achieved higher percentage success only in the map interpretation skill. The Student's t-test indicated statistically significant differences in all three investigated map skills ($p < 0.05$). The Cohen's *d* was lower than 0.50 for all three skills, indicating only a small effect size. Considering this fact, we do not anticipate significant differences in pupils' map skills based on gender.

***Tab. 3.*** *Comparison of test results based on gender*

| Skills | Item | Girls | | Boys | | p-value | Effect size Cohen *d* |
|---|---|---|---|---|---|---|---|
| | | The success rate for an item [%] | The success rate for a skills [%] | The success rate for an item [%] | The success rate for a skills [%] | | |
| Reading a map * | 1 | 77,19 | 69,09 | 81,96 | 71,41 | 0,01 | 0,15 |
| | 2 | 53,75 | | 65,64 | | | |
| | 3 | 61,88 | | 62,89 | | | |
| | 4 | 75,60 | | 76,29 | | | |
| | 5 | 70,49 | | 71,48 | | | |
| | 6 | 69,14 | | 67,27 | | | |
| | 7 | 78,15 | | 79,21 | | | |
| | 8 | 76,87 | | 80,41 | | | |
| | 9 | 58,69 | | 57,56 | | | |
| Analysing a map* | 10 | 57,58 | 48,66 | 65,64 | 51,34 | 0,005 | 0,16 |
| | 11 | 72,41 | | 71,48 | | | |
| | 12 | 68,58 | | 71,48 | | | |
| | 13 | 18,66 | | 27,49 | | | |
| | 14 | 65,23 | | 60,65 | | | |
| | 15 | 37,32 | | 37,97 | | | |
| | 16 | 29,03 | | 34,19 | | | |
| | 17 | 65,23 | | 67,18 | | | |
| | 18 | 23,92 | | 25,95 | | | |
| Interpreting a map * | 19 | 55,66 | 55,88 | 58,93 | 45,68 | 0,01 | 0,18 |
| | 20 | 67,15 | | 71,99 | | | |
| | 21 | 35,57 | | 36,08 | | | |
| | 22 | 19,62 | | 21,99 | | | |
| | 23 | 55,66 | | 25,77 | | | |
| | 24 | 56,14 | | 59,28 | | | |

* statistically significant differences ($p < 0.05$)

***The map skills level among pupils in relation to the type of school they attend***

The level of map skills among pupils based on the type of school they attend was another factor we included in the analysis of obtained data. On average, pupils from the eight-year grammar schools achieved 11.83 points (SD = 7.19), while pupils from regular primary schools scored 13.73 points (SD = 5.21). The result of the Student's t-test (t = 4.150; p = 0.00003)

demonstrated statistically significant differences between the two groups in favor of the primary school pupils (Tab. 4). The Cohen's *d* index of 0.51 indicates a moderate effect size between the compared groups. This result suggests a certain difference in performance between primary school pupils and eight-year grammar school pupils, yet it is important to note that this difference is not substantial or significant enough to be clearly identified as highly crucial. Comparison of the medians of both groups for each skill demonstrated statistically significant differences in favor of the primary school pupils. Cohen's *d* index showed a moderate effect size for all three skills, indicating significant differences in map skills in favor of primary school pupils.

***Tab. 4.*** *Comparison of test results by school type*

| | | Eight-year grammar schools | | Primary school | | | |
|---|---|---|---|---|---|---|---|
| **Skills** | **Item** | **The success rate for an item [%]** | **The success rate for a skills [%]** | **The success rate for an item [%]** | **The success rate for a skills [%]** | **p-value** | **Effect size Cohen *d*** |
| Reading a map* | 1 | 68,82 | 60,56 | 81,23 | 71,78 | 0,00023 | 0,44 |
| | 2 | 60,00 | | 59,38 | | | |
| | 3 | 57,06 | | 63,23 | | | |
| | 4 | 63,53 | | 77,96 | | | |
| | 5 | 63,53 | | 72,18 | | | |
| | 6 | 55,00 | | 70,40 | | | |
| | 7 | 62,35 | | 81,33 | | | |
| | 8 | 64,12 | | 80,94 | | | |
| | 9 | 50,59 | | 59,38 | | | |
| Analysing a map* | 10 | 64,12 | 48,56 | 61,02 | 50,68 | 0,00014 | 0,49 |
| | 11 | 65,29 | | 73,05 | | | |
| | 12 | 60,59 | | 71,51 | | | |
| | 13 | 20,59 | | 23,29 | | | |
| | 14 | 56,47 | | 64,10 | | | |
| | 15 | 35,88 | | 37,92 | | | |
| | 16 | 27,65 | | 32,15 | | | |
| | 17 | 55,88 | | 67,85 | | | |
| | 18 | 22,94 | | 25,22 | | | |
| Interpreting a map * | 19 | 50,59 | 38,14 | 58,33 | 54,60 | 0,000026 | 0,61 |
| | 20 | 60,00 | | 71,03 | | | |
| | 21 | 35,29 | | 35,90 | | | |
| | 22 | 13,53 | | 21,94 | | | |
| | 23 | 21,18 | | 81,23 | | | |
| | 24 | 48,24 | | 59,19 | | | |

* statistically significant differences ($p < 0.05$)

***The level of pupils' map skills in relation to the school's location***

Within the statistical analysis, we focused on determining whether there are statistically significant differences in the level of map skills among pupils based on the school's location. Pupils attending schools in urban areas obtained an average of 12.12 points (SD = 5.50), whereas pupils attending schools in rural areas obtained an average of 14.98 points (SD = 5.25). The Student's t-test demonstrated statistically significant differences between the compared groups, favoring pupils attending schools in rural areas ($p < 0.05$). The Cohen's *d* result indicated a moderate effect size. Comparison of individual examined map skills revealed that pupils attending schools in rural areas achieved better percentage success rates across all skills

(Tab. 5). Based on the determined Cohen's *d* coefficient, it can be confirmed that a moderate effect size was achieved across all compared skills. Hence, it can be concluded that there are statistically significant differences in the level of pupils' skills between those attending schools in urban and rural areas, and this difference is not solely due to variations in pupil numbers within the compared groups.

***Tab. 5.*** *Comparison of test results based on school location*

| | | Urban areas pupils | | Rural areas pupils | | | |
|---|---|---|---|---|---|---|---|
| **Skills** | **Item** | **The success rate for an item [%]** | **The success rate for a skills [%]** | **The success rate for an item [%]** | **The success rate for a skills [%]** | **p-value** | **Effect size Cohen *d*** |
| Reading a map* | 1 | 75,08 | 64,67 | 84,48 | 76,52 | 0,00024 | 0,54 |
| | 2 | 51,40 | | 68,61 | | | |
| | 3 | 55,30 | | 70,37 | | | |
| | 4 | 70,56 | | 82,01 | | | |
| | 5 | 69,00 | | 73,19 | | | |
| | 6 | 63,63 | | 73,46 | | | |
| | 7 | 73,83 | | 84,13 | | | |
| | 8 | 71,65 | | 86,42 | | | |
| | 9 | 51,56 | | 65,61 | | | |
| Analysing a map* | 10 | 55,45 | 44,37 | 68,25 | 56,26 | 0,000013 | 0,50 |
| | 11 | 67,60 | | 76,90 | | | |
| | 12 | 63,86 | | 76,90 | | | |
| | 13 | 17,29 | | 29,28 | | | |
| | 14 | 56,54 | | 70,38 | | | |
| | 15 | 32,71 | | 43,21 | | | |
| | 16 | 23,52 | | 40,56 | | | |
| | 17 | 60,12 | | 73,02 | | | |
| | 18 | 22,27 | | 27,87 | | | |
| Interpreting a map * | 19 | 48,60 | 38,49 | 67,02 | 50,70 | 0,00001 | 0,47 |
| | 20 | 62,62 | | 77,25 | | | |
| | 21 | 31,15 | | 41,09 | | | |
| | 22 | 18,69 | | 23,10 | | | |
| | 23 | 75,08 | | 31,39 | | | |
| | 24 | 51,71 | | 64,37 | | | |

* statistically significant differences ($p < 0.05$)

## Discussion

Geography education focuses on improving pupils' geographical literacy. An essential component of this literacy is map literacy, which includes map skills (Koç and Önal 2016). Several studies (e.g., Utami, Zain and Sumarmi 2018, Aksoy 2019) have pointed out that the level of map skills can significantly impact overall geographical literacy. Despite their undeniable significance, various studies suggest that pupils often lack the necessary skills required to work with maps (e.g., Mwenesongole 2009, Unlu 2011, Havelková and Hanus 2018, Mukondeleli 2018, Eze 2021, Kwayi 2022, Pčolová 2023). Similarly, our research data indicated that the overall level of map skills among pupils at the end of lower secondary education at the age of 14-15 is only average. Pupils in the administered map skills test achieved an average success rate of 56.08%. This result cannot be deemed sufficient. Ooms et al. (2016), in their study among pupils aged 11-18 in Belgium, highlighted that as age increases, so does the level of map skills. However, it is important to note that a larger portion of pupils after

completing lower secondary education in Slovakia move on to vocational high schools where subjects (such as geography) that would further enhance map skills are not taught.

During the research implementation, we focused on examining three fundamental map-related skills—reading, analysis, and map interpretation. A well-developed skill is considered to achieve a success rate of more than 75% (Kireš and Jurková 2021). However, in none of the scrutinized skills did the pupils reach this level of success. Reading the map was perceived as the most developed skill, with the pupils achieving a success rate of 70.02%. This outcome can be justified by the set requirements at the primary education level (ISCED 1), where one of the aims is for pupils to acquire the skill of map reading (ŠPÚ 2014b). Similarly, in textbooks of some subjects at the primary level of education in Slovakia, there are tasks that require pupils to obtain necessary information through the usage of the map legend and identify objects based on map symbols. On the contrary, the skill associated with map interpretation was considered the least developed, with pupils achieving a success rate of 44.20%. Havelková and Hanus (2018) also found a similar outcome in their research and highlighted that the type of map used during testing could significantly influence the pupils' results. Additionally, factors other than the type of map might contribute to the insufficient level of skill in map interpretation. The application of this skill involves a multi-step cognitive process that necessitates abstract thinking, knowledge related to the content and characteristics of the map, while also utilizing other map-related skills (Bednarz, Acheson and Bednarz 2006, Havelková and Hanus 2018).

Within our research, we paid attention to the influence of various factors on pupils' map-related skills, a subject of numerous studies (e.g., Gilmartin and Patton 1984, Havelková and Hanus 2018, Sarif 2022). Specifically, we focused on the potential impact of three factors that may determine educational outcomes: gender, school type, and its location. The collected data indicated statistically significant differences among pupils in each skill based on all three variables. Concerning gender, we found statistically significant differences in favor of boys. However, the effect size indicated that the difference between gender groups was small. Further studies also indicate that boys might have higher levels of map-related skills compared to girls (Henrie et al. 1997, Moon et al. 2016, Sarif 2022). Similarly, Gilmartin and Patton (1984) found in their research that boys could extract spatial information from maps more effectively than girls. The potential advantage for boys might be related to mathematical competencies and spatial abilities, which could be better developed among boys (Sherman 1980, Beilock et al. 2010, Ganley and Vasilyeva 2011, Havelková and Hanus 2018,). Šmída (2022) also highlights that using maps as a complex source of geographic information requires a certain level of mathematical literacy. However, this mutual relationship requires further exploration. Besides the influence of mathematical competencies, spatial skills, and overall mathematical literacy, it is necessary to consider the impact of interest in education in the given area. Kubiatko, Mrazková and Janko (2012) found that boys perceive geography more positively as a subject compared to girls. The perception of the subject can be a significant predictor of educational performance (Adediwura and Tayo 2007).

Various studies (Goyal and Pandey 2009, Rasool and Bhat 2018, Sarif 2022) have indicated the existence of differences in pupils' map skills based on the type of school they attend. However, there have been no studies conducted in Slovakia specifically focusing on examining differences in the level of map skills between pupils attending primary schools and eight-year grammar schools. Eight-year grammar schools represent a selective type of school intended for only 5% of the population. Therefore, it is presumed that these pupils should achieve better educational outcomes compared to pupils attending primary schools. Nevertheless, the analysis of research results revealed that pupils attending regular primary schools have a higher level of map skills. This result may be influenced by various factors. Differences between schools may be influenced by the qualifications of teachers and other staff, their engagement

in teaching, the facilities of the school, and the size of the school. Despite the fact that educational standards for eight-year grammar schools and primary schools are the same (ŠPÚ 2014a), we may find certain differences in teaching methods. Teachers at primary schools often focus on practical and specific aspects of teaching, which may include more practical activities or applied learning, such as working with maps. In contrast, at eight-year grammar schools, we may encounter teachers aiming for a deeper theoretical approach to the curriculum, which may reduce the opportunity for practical application of the curriculum. This fact is also reflected in the evaluation report by Burjan et al. (2017), who recommend introducing a less academically and theoretically oriented general education approach to education in the conditions of eight-year grammar schools. Considering the above, it is necessary to pay increased attention to examining the differences between pupils attending primary and eight-year grammar schools, taking into account the influence of factors such as school and teacher.

The school's location is often considered a significant factor in relation to pupils' educational outcomes. Some studies have indicated that pupils in urban schools may achieve better educational outcomes in cartography compared to those in rural areas (e.g., Peevely and Ray 2001, Roscigno and Crowley 2001, Reeves and Bylund 2005, Sarif 2022). This result may be influenced by several factors, such as better access to educational resources in urban areas (Wood 2023), often higher socioeconomic status of urban pupils (Hoque, Anwaruzzaman and Kasemi 2019, Jošić et al. 2022), or the existence of a digital divide between rural and urban schools (Wang 2013). However, comparing data from pupils in urban and rural schools revealed that statistically, pupils attending rural schools performed better on the administered test. Similarly, the research conducted by Adeyinka and Ogunbiyi (2023) highlighted that pupils from rural areas may achieve better results in geography education. Possible reasons for this outcome might include better access for pupils in rural areas to activities that enhance spatial imagination and environmental orientation. Another significant factor could be the fact that rural schools typically have fewer pupils, allowing for a more individualized approach from the teacher (Monk 2007).

## Conclusion

The use of maps in teaching and enhancing the level of map skills is often a subject of discussion when addressing the nature of geographical education. Today, these skills undoubtedly represent a significant component of geographic (Hakan and Demir 2014, Artvinli and Dönmez 2020) and constitute essential prerequisites for life in the 21st century (Tyner 2014). These skills enable individuals not only to navigate space but also to utilize diverse information embedded within the cartographic language of map content. Furthermore, these skills provide the capacity to analyse and interpret various geographical data and relationships, leading to a better understanding of the world around us. Within education, map skills play a crucial role in fostering pupils' critical and analytical thinking. Engaging with maps helps pupils develop their ability to process and evaluate information, thereby strengthening their capacity for learning and problem-solving.

The outcomes of the conducted research have shown that the level of map skills required for reading, analysing, and interpreting maps among Slovak pupils at the end of lower secondary education is only at an average level. Therefore, it is crucial to reassess the State Educational Program and implement measures that would lead to an elevation of map skills among pupils, especially concerning the analysis and interpretation of map content. Data analysis from the research has indicated the necessity of implementing measures aimed at enhancing map skills among pupils, particularly in the context of analysing and interpreting map content. Assessing the current level of map skills among pupils at the end of lower secondary education can contribute to identifying issues in this field and seeking ways to elevate this level through

geographical education. Geography, in fact, stands as an educational subject that systematically raises the level of map skills among pupils (Dikshit 2004, Sarkar 2009). The delivery of educational content in this subject must involve pupils actively engaging with maps. Through active engagement with maps, pupils can not only acquire the content of their education but also enhance their level of map skills.

## Limitations of the study

The primary limitation of the research is the data acquisition method used for analysis through an available selection process. Similarly, for obtaining the necessary data, we used a non-standardized test with multiple-choice options for the correct answer. Such a test only allows for obtaining information about the current level of pupils' map skills and not about their depth. Among other limitations of the conducted research is the restriction in the number of involved pupils due to the method by which the research tool was administered to schools. Specifically, the test was made accessible to pupils in an electronic format. This limitation could have affected school participation in the research, as some schools in Slovakia might lack the necessary technological equipment to enable every pupil to complete the test at the same time.

## References


ADEDIWURA, A. A., TAYO, B. 2007: Perception of teachers' knowledge, attitude and teaching skills as predictor of academic performance in Nigerian secondary schools. *Educational Research and Reviews*, 2(7), 165-171.

ADEPOJU, T. L., AKINWUMI, F. S. 2001: Location of secondary schools as a factor in determining academic performance of students. *Ibadan Journal of Educational Studies*, 1(2), 410-420.

ADEYINKA, A. S., OGUNBIYI, O. M. 2023: A Rural-Urban Comparison of the Effectiveness of Think-Pair-Share (TPS) Strategy of Instruction on Senior Secondary School Students' Academic Achievement in Geography. *CMU Academy Journal of Management and Business Education*, 2(1), 25-34. DOI: https://doi.org/10.53797/cjmbe.v2i1.4.2023.

AKSOY, B. 2019: Determination of map literacy of undergraduate geography students. *Review of International Geographical Education Online*, 9(3), 591-603. DOI: https://doi.org/10.33403/rigeo.582301.

ALBERT, G., ILYÉS, V., KIS, D., SZIGETI, C., VÁRKONYI, D. 2016: Testing the map reading skills of university students. In Bandrova, T., Konečný, M. eds. *6th International Conference on Cartography and GIS*, Albena (Bulgarian Cartographic Association), 188-199.

ALTMAN, D. G., BLAND, J. M. 1995: Statistics notes: the normal distribution. *BMJ*, 310(6975), 298. DOI: https://doi.org/10.1136/bmj.310.6975.298.

ARTVINLI, E., DÖNMEZ, L. 2020: How Do Geography Textbooks Deal with Map Skills? A Comparison of Turkey and England. *Romanian Review of Geographical Education*, 9(2), 23-45. DOI: http://doi.org/10.23741/RRGE220202.

BEDNARZ, S. W., ACHESON, G., BEDNARZ, R. S. 2006: Maps and map learning in social studies. *Social Education*, 70(7), 398-404.

BEILOCK, S. L., GUNDERSON, E. A., RAMIREZ, G., LEVINE, S. C. 2010: Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences*, 107(5), 1860-1863. DOI: https://doi.org/10.1073/pnas.0910967107.

BLAUT, J. M. 1997: The mapping abilities of young children: Children can. *Annals of the Association of American Geographers*, 87(1), 152-158. DOI: https://doi.org/10.1111/0004-5608.00045.

BURJAN, V., FTÁČNIK, M., JURÁŠ, I., VANTUCH, J., VIŠŇOVSKÝ, E., VOZÁR, L. 2017: Učiace sa Slovensko – Národný program rozvoja výchovy a vzdelávania – Návrh na verejnú diskusiu. *Ministerstvo školstva, vedy, výskumu a športu* [cit. 2023-12-06]. Retrived from: https://www.minedu.sk/data/files/6987_uciace_sa_slovensko.pdf.

CARBONELL-CARRERA, C., HESS MEDLER, S. 2017: Spatial orientation skill improvement with geospatial applications: Report of a multi-year study. *ISPRS International Journal of Geo-Information*, 6(9), 278. DOI: https://doi.org/10.3390/ijgi6090278.

CARTER, J. R. 2005: The many dimensions of map use. In *Proceedings of the XXII International Cartographic Conference*, 1-9.

COLLINS, L., 2018: The Impact of Paper versus Digital Map Technology on Students' Spatial Thinking Skill Acquisition.Journal of Geography. *Journal of Geography*, 117(4), 137-152. DOI: https://doi.org/10.1080/00221341.2017.1374990.

ČIPKOVÁ, E., FUCHS, M. 2020: Hodnotenie vybraných bádateľských zručností študentov učiteľstva biológie. *Scientia in educatione*, 11(2), 2-13. DOI: https://doi.org/10.14712/18047106.1884.

ČIPKOVÁ, E., FUCHS, M., ŠMIDA, D. 2023: Úroveň bádateľských zručností žiakov 6. ročníka základných škôl. *Scientia in educatione*, 14(1), 2-14. DOI: https://doi.org/10.14712/18047106.2276.

ČTRNÁCTOVÁ, H., CÍDLOVÁ, H., TRNOVÁ, E., BAYEROVÁ, A., KUBĚNOVÁ, G. 2013: Úroveň vybraných chemických dovedností žáků základních škol a gymnázií. *Chemické listy*, 107(11), 897-905.

DEMPSEY, C. L. 2003: *The relevance of philosophy: Heidegger's problem with Kantian metaphysics – dissertation thesis*. New York (New School University).

DIKSHIT, R. D. 2004: *Geographical thought: a contextual history of ideas*. Delhi (PHI Learning Pvt. Ltd.).

ELLIOTT, A. C., WOODWARD, W. A. 2007: *Statistical analysis quick reference guidebook: With SPSS examples*. London (Sage Publicatioons, Inc.).

ELBOW, G. S., SHARMA, M. B. 2000: *Using Internet Primary Sources to Teach Critical Thinking Skills in Geography*. Washington (Bloomsbury Publishing United States of America).

ENRIGHT, M. 2021: Teaching Map Literacy Is Important Part of Having an Informed Public. *University Of Connecticut*. [cit. 2023-12-05]. Retrieved from: https://today.uconn.edu/2021/12/teaching-map-literacy-is-important-part-of-having-an-informed-public/.

EROL, H. 2020: 8th Grade Students' Positioning Skills on the Map. *Eurasian Journal of Educational Research*, 20(88), 67-86. DOI: https://doi.org/10.14689/ejer.2020.88.3.

EZE, E. 2021: Why secondary school geography students perform poorly in external examinations. *Journal of Geography*, 120(2), 51-60. DOI: https://doi.org/10.1080/00221341.2020.1860114.

FRASER TAYLOR, D. R., CAQUARD, S. 2006: Cybercartography: maps and mapping in the information era. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 41(1), 1-6. DOI: https://doi.org/10.3138/U631-37K3-3NL6-4136.

FRITZ, C. O., MORRIS, P. E., RICHLER, J. J. 2012: Effect size estimates: current use, calculations, and interpretation. *Journal of experimental psychology: General*, 141(1), 2-18. DOI: https://doi.org/10.1037/a0024338.

GANLEY, C. M., VASILYEVA, M. 2011: Sex differences in the relation between math performance, spatial skills, and attitudes. *Journal of Applied Developmental Psychology*, 32(4), 235-242. DOI: https://doi.org/10.1016/j.appdev.2011.04.001.

GIANNAKOU, O., KLONARI, A. I. 2019: Digital storytelling in education using Webgis. *European Journal of Geography*, 10(3), 154-172.

GILMARTIN, P. P., PATTON, J. C. 1984: Comparing the sexes on spatial abilities: map-use skills. *Annals of the Association of American Geographers*, 74(4), 605-619. DOI: https://doi.org/10.1111/j.1467-8306.1984.tb01477.x.

GOYAL, S., PANDEY, P. 2009: *How do government and private schools differ? Findings from two large Indian states*. Washington (International Bank for Reconstruction and Development/The World Bank).

GÖKÇE, N. 2015: Social studies in improving students' map skills: Teachers' opinions. *Educational Sciences: Theory & Practice*, 15(5), 1345-1362. DOI: https://doi.org/10.12738/estp.2015.5.0071.

GROFELNIK, H., PAP, I. 2013: Mastery of Long-Term Cartographic Knowledge and Skills of New Secondary Level Pupils. *Kartografija i Geoinformacije*, 12(19), 86-102.

HAKAN, K. O. Ç., DEMIR, S. B. 2014: Developing valid and reliable map literacy scale. *Review of International Geographical Education Online*, 4(2), 120-137.

HANUS, M., HAVELKOVÁ, L. 2019: Teachers' Concepts of Map-Skill Development. *Journal of Geography*, 118 (3), 101-116. DOI: https://doi.org/10.1080/00221341.2018.1528294.

HANUS, M., HAVELKOVÁ, L., KOCOVÁ, T., BERNHÄUSEROVÁ, V., ŠTOLCOVÁ, K., FENCLOVÁ, K., ZÝMA, M. 2020: *Práce s mapou ve výuce: certifikovaná metodika*. Praha (Nakladatelství P3K s. r. o.).

HANUS, M., MARADA, M. 2014: Mapové dovednosti: vymezení a výzkum. *Geografie*, 119(4), 406-422. DOI: https://doi.org/10.37040/geografie2014119040406.

HART, R. 1979: *Children's experience of place*. New York (Irvington).

HAVELKOVÁ, L., HANUS, M. 2018: The impact of map type on the level of student map skills. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 53(3), 149-170. DOI: https://doi.org/10.3138/cart.53.3.2017-0014.

HAVELKOVA, L., HANUS, M. 2019: Map skills in education: A systematic review of terminology, methodology and influencing factors. *Review of International Geographical Education Online*, 9(2), 361-401. DOI: https://doi.org/10.33403/rigeo.591094.

HEALE, R., TWYCROSS, A. 2015: Validity and reliability in quantitative studies. *Evidence-based nursing*, 18(3), 66-67. DOI: http://dx.doi.org/10.1136/eb-2015-102129.

HEMMER, I., HEMMER, M., NEIDHARDT, E., OBERMAIER, G., UPHUES, R., WRENGER, K. 2015: The influence of children's prior knowledge and previous experience on their spatial orientation skills in an urban environment. *Education*, 43(2), 184-196. DOI: https://doi.org/10.1080/03004279.2013.794852.

HENRIE, R. L., ARON, R. H., NELSON, B. D., POOLE, D. A. 1997: Gender-related knowledge variations within geography. *Sex Roles*, 36(1), 605-623. DOI: https://doi.org/10.1023/A:1025618024694.

HOQUE, S., ANWARUZZAMAN, A. K. M., KASEMI, N. 2019: Levels of Gender Disparity of Literacy in the District of Malda, West Bengal: A Geo-spatial Analysis. *Indian Journal of Spatial Science*, 10(1), 72-78. DOI: https://doi.org/10.13140/RG.2.2.14644.30086.

HORNÁČKOVÁ, A. 2006: Vedomosti žiakov o vzniku a vývoji života na zemi. In Híc, P. ed. *Facultatis Paedagogicae Universitatis Tyrnaviensis*. Trnava (Trnavská univerzita v Trnave), 12-18.

HSU, H. P., TSAI, B. W., CHEN, C. M. 2018: Teaching topographic map skills and geomorphology concepts with Google Earth in a one-computer classroom. *Journal of Geography*, 117(1), 29-39. DOI: https://doi.org/10.1080/00221341.2017.1346138.

JOŠIC, S., PAVEŠIC, B. J., GUTVAJN, N., ROŽMAN, M. 2022. Scaffolding the Learning in Rural and Urban Schools: Similarities and Differences. *Dinaric Perspectives on TIMSS* 2019, 213-239.

KASTENS, K. A., KAPLAN, D., CHRISTIE-BLICK, K. 2001: Development and evaluation of "Where Are We?" map-skills software and curriculum. *Journal of Geoscience Education*, 49(3), 249-266. DOI: https://doi.org/10.5408/1089-9995-49.3.249.

KASTENS, K. A., LIBEN, L. S. 2007: Eliciting self-explanations improves children's performance on a field-based map skills task. *Cognition and Instruction*, 25(1), 45-74. DOI: https://doi.org/10.1080/07370000709336702.

KHULLAR, D. R. 2011: *Essentials of Practical Geography*. Jalandhar (New Academic Publishing Co.).

KIREŠ, M., JURKOVÁ, V. 2021: Development of inquiry skills at lower secondary school level. In Jarosievitz, B., Sükösd. C. *Journal of Physics: Conference Series*. Budapešť (IOP Publishing), pp. 1-6. DOI: https://doi.org/10.1088/1742-6596/1929/1/012028.

KOÇ, H., ÖNAL, H. 2016: Investigating Geography Teacher Candidates' Map Literacy Levels in Terms of Different Variables. In Efe, R., Koleva, I., Atasoy, E., Cürebal, Í. *Developments in Educational Sciences*. Sofia (St. Kliment Ohridski University Press), 727-744.

KUBIATKO, M., MRAZKOVA, K., JANKO, T. 2012: Gender and grade level as factors influencing perception of geography. *Review of International Geographical Education Online*, 2(3), 289-302.

KUMAR, M. R. V., VAKKIL, M. 2020: Effect of Activity-Based Instruction on the Attainment of Mastery Levels in Map Reading Skills among Elementary Level Teacher Trainees. *Education India Journal: A Quarterly Refereed Journal of Dialogues on Education*, 9(4), 281-297.

KURAJOVÁ STOPKOVÁ, J., KURAJ, J. 2006: Vzdelávacie výsledky žiakov 8. ročníka ZŠ a 4. ročníka gymnázia s osemročným štúdiom z matematiky a prírodovedných predmetov v rámci štúdie TIMSS 2003 na národnej úrovni. In Híc, P. ed. *Facultatis Paedagogicae Universitatis Tyrnaviensis*. Trnava (Trnavská univerzita v Trnave), 36-45.

KWAYI, A. M. 2022: *Challenges experienced by grade 6 Social Sciences teachers when teaching map skills – doctoral dissertation*. Johannesburg (University of Johannesburg).

LATEH, H. H., RAMAN, A. 2005: A study on the use of interactive web-based maps in the learning and teaching of geography. *Malaysian Online Journal of Instructional Technology*, 2(3), 99-105.

LOBBEN, A. K. 2004: Tasks, strategies, and cognitive processes associated with navigational map reading: A review perspective. *The Professional Geographer*, 56(2), 270-281. DOI: https://doi.org/10.1111/j.0033-0124.2004.05602010.x.

LOPEZ, V., WHITEHEAD, D. 2013: Sampling data and data collection in qualitative research. In Schneider, Z., Whitehead, D., LoBiondo-Wood, G., Haber, J. *Nursing & midwifery research: Methods and appraisal for evidence-based practice*. Sydney (Elsevier), 123-140.

MALIK, T. 2015: Enhancing mapping skills-problems and possibilities. *Indian Journal of Applied Research*, 5(4), 183-185.

MCCLURE, R. W. 1992: *A conceptual model for map skills curriculum development based upon a cognitive field theory philosophy – dissertation thesis*. Oklahoma (Oklahoma State University).

MEILINGER, T., KNAUFF, M. 2008: Ask for directions or use a map: A field experiment on spatial orientation and wayfinding in an urban environment. *Journal of Spatial Science*, 53(2), 13-23. DOI: https://doi.org/10.1080/14498596.2008.9635147.

MEYER, J. M. 1973: Map skills instruction and the child's developing cognitive abilities. *Journal of Geography*, 72(6), 27-35.

MISHRA, P., SINGH, U., PANDEY, C. M., MISHRA, P., PANDEY, G. 2019: Application of student's t-test, analysis of variance, and covariance. *Annals of cardiac anaesthesia*, 22(4), 407-411. DOI: https://doi.org/10.4103/aca.ACA_94_19.

MOON, Y., JO, H., KIM, J., RYU, J. 2016: Exploring gender differences in spatial orientation ability on representing cognitive map. *International Journal of Psychology and Behavioral Science*, 6(2), 91-98. DOI: http://article.sapub.org/10.5923.j.ijpbs.20160602.09.html .

MONK, D. H. 2007. Recruiting and retaining high-quality teachers in rural areas. *The future of children*, 17(1), 155-174.

MRÁZKOVÁ, K., HOFMANN, E. 2011: The Level of Map Skills Development of Elementary School Pupils. In Svobodová, H. ed. *Geography and Geoinformatics: Challenge for Practise and Education*. Brno (Masarykova univerzita), 188-194.

MUEHRCKE, P. 1981: Maps in geography. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 18(2), 1-41. DOI: https://doi.org/10.3138/Y0U7-U48P-617N-27R4.

MUIR, S. P. 1985: Understanding and improving students' map reading skills. *The Elementary School Journal*, 86(2), 207-216.

MUKONDELELI, A. 2018: Teaching of geography mapwork in Grade 12: a case of Nzhelele West Circuit in Vhembe District – doctoral dissertation. Thohoyandou (University of Venda).

MWENESONGOLE, E. 2009: The Factors Influencing Learner Achievement in Geography Mapwork at Grade 12 Level. *International Journal of Learning*, 16(8), 529-544.

NAZARENKO, T., TOPUZOV, O., CHASNIKOVA, O., DUBROVINA, I. 2021: Role of geography teacher in forming the pupils' cartographic competence. *Prace i Studia Geograficzne*, 66(2), 43-53. DOI: https://doi.org/10.48128/pisg/2021-66.2-03.

NDLWANA, M. 1991: *A Critical Analysis of Problems Encountered by Senior Secondary School Pupils in the Reading and Interpretation of 1: 50,000 Topographical Maps and Aerial Photo with Special Reference to Black Pupils in Transkei – doctoral dissertation.* Makhande (Rhodes University).

NTUMI, S., AGBENYO, S., BULALA, T. 2023: Estimating the Psychometric Properties ("Item Difficulty, Discrimination and Reliability Indices") of Test Items Using Kuder-Richardson Approach (KR-20). *Shanlax International Journal of Education*, 11(3), 18-28. DOI: https://doi.org/10.34293/education.v11i3.6081.

NUNNALLY, J. C., BERNSTEIN, I. H. 1978: P*sychometric testing.* New York (McGraw-Hill).

NYONI, E. 2021: A Geography Teacher's Responsiveness to the Cognitive Academic Language Proficiency (CALP) Needs of Zimbabwean English Second Language (ESL) Learners in Syllabus Interpretation and Instructional Design. *Journal of African Education*, 2(1), 149. DOI: https://doi.org/10.31920/2633-2930/2021/v2n1a7.

OOMS, K., DE MAEYER, P., DUPONT, L., VAN DER VEKEN, N., VAN DE WEGHE, N., VERPLAETSE, S. 2016: Education in cartography: what is the status of young people's map-reading skills?. *Cartography and Geographic Information Science*, 43(2), 134-153. DOI: https://doi.org/10.1080/15230406.2015.1021713.

OSACI-COSTACHE, G., COCOŞ, O., COCOŞ, A. 2014: Online Cartographic Materials for Geographical Higher Education: Opportunity or Threat. In *Proceedings of the 9th International Conference on Virtual Learning ICVL*. Bukurešť (Bucharest University Press), 218-224.

PALLANT, J. 2020: *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. London (McGraw-hill education). DOI: https://doi.org/10.4324/9781003117452.

PČOLOVÁ, J. 2023: *Zisťovanie úrovne kartografickej gramotnosti žiakov deviateho ročníka základnej školy*. Bratislava (Prírodovedecká fakulta Univerzity Komenského v Bratislave).

PEEVELY, G., RAY, J. 2001: The Relationship of Rurality and Education Achievement Outcomes. In *American Research Association annual conference*. Washington (American Educational Research Association).

PETERSON, M. P. 2005: A Decade of Maps and the Internet. In Peterson M.P. ed. *Proceedings of International Cartographic Conference*. Oxford (Elsevier Science).

PRAVDA, J. 2021: Výskum niektorých stránok kartografickej gramotnosti. In Čada, V., Jedlička, K. eds. *Úloha kartografie v geoinformační společnosti. Sborník 14. kartografické konference*. Plzeň (Západočeská univerzita, Kartografická společnost ČR).

PROKOP, P., KVASNIČÁK, R., PIŠTOVÁ, Z. 2006: Predstavy žiakov o potravových vzťahoch v ekosystémoch. *Paidagogos*, 2(1).

RASOOL, R., BHAT, M. S. 2018: Academic achievement of government and private secondary school students with respect to their school environment. *International Journal of Movement Education and Social Science*, 7(2), 162-170.

REEVES, E.B., BYLUND, R.A. 2005: Are rural schools inferior to urban schools? A multilevel analysis of school accountability trends in Kentucky. *Rural Sociology*, 70(3), 360-386. DOI: https://doi.org/10.1526/0036011054831215.

REYES NUNEZ, J. J. 2020: Introducing the special issue: some thoughts on school cartography. *International Journal of Cartography*, 6(3), 267-269. DOI: https://doi.org/10.1080/23729333.2020.1748341.

ROKOS, L., VOMÁČKOVÁ, V. 2017: Hodnocení efektivity badatelsky orientovaného vyučování v laboratorních pracích při výuce fyziologie člověka na základní škole a nižším stupni gymnázia. *Scientia in educatione*, 8(1), 32-45. DOI: https://doi.org/10.14712/18047106.365.

ROSCIGNO, V.J., CROWLEY, M.L. 2001: Rurality, institutional disadvantage, and achievement/attainment. *Rural Sociology*, 66(2), 268-292. DOI: https://doi.org/10.1111/j.1549-0831.2001.tb00067.x.

ŘEZNÍČKOVÁ, D., CÍDLOVÁ, H., ČÍŽKOVÁ, V., ČTRNÁCTOVÁ, H., ČUDOVÁ, R., HANUS, M., TRNOVÁ, E. 2013: *Dovednosti žáků ve výuce biologie, geografie a chemie*. Praha (Nakladatelství P3K).

SAKU, J. 1992: Map use teaching and experience. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 29(3-4), 38-45. DOI: https://doi.org/10.3138/Q331-U822-44W3-7790.

SAPUTRO, R., LIESNOOR, D., HARDATI, P. 2020: The Students Spatial Critical Thinking Skill by Using Map and Remote Sensing Imagery on Geography Lesson. In Ahmadi, F., Kristianto, V. A., Hamdani, G. P. et al. eds. *International Conference on Science and Education and Technology (ISET 2019).* (Atlantis Press), 250-254. DOI: https://doi.org/10.2991/assehr.k.200620.049.

SARIF, N. 2022: Map Skills of Secondary Students in Relation to their Gender, Locality, and School type. *Voices of Teachers and Teacher Educators*, 11(2), 106-116.

SARIPUDIN, D., RATMANINGSIH, N., ANGGRAINI, D. 2022: Smart Maps Indonesia Based on Augmented Reality as Digital Learning Resources of Social Studies. *The New Educational Review*, 67(1), 172-182. DOI: https://doi.org/10.15804/tner.22.67.1.13.

SARKAR, A. 2009: *Practical Geography. A Systematic Approach*. Kolkata (Orient BlackSwan Private Limited).

SCHEE, J. V. D., DIJK, H. V. 1999: The effect of student freedom of choice in learning map skills. *International Research in Geographical and Environmental Education*, 8(3), 256-267. DOI: https://doi.org/10.1080/10382049908667615.

ŞEYMA, U. Y. A. R., YAYLA, O., ZÜNBER, H. 2022: Examination of map reading skills with orienteering activity: An example of Many Facet Rasch Model. *International Journal of Assessment Tools in Education*, 9(Special Issue), 258-282. DOI: https://doi.org/10.21449/ijate.1116273.

SHERMAN, J. 1980: Mathematics, spatial visualization, and related factors: Changes in girls and boys, Grades 8–11. *Journal of Educational psychology*, 72(4), 476-482. DOI: https://doi.org/10.1037/0022-0663.72.4.476.

SHIN, E. K. 2006: Using geographic information system (GIS) to improve fourth graders' geographic content knowledge and map skills. *Journal of geography*, 105(3), 109-120. DOI: https://doi.org/10.1080/00221340608978672.

SÖNMEZ, Ö. F. 2010: *Map skills in primary school social studıes education - doctoral thesis*. Ankara (Gazi University Institute of Educational Sciences, Ankara).

ŠMÍDA, J. 2022: Map skills as a basis for building digital competencies in geography education under the Czech national curriculum. In *Abstracts of the International Cartographic Association*. Bern (ICA, Copernicus Publications), 1-2. DOI: https://doi.org/10.5194/ica-abs-5-25-2022.

ŠPÚ 2014a: Inovovaný Štátny vzdelávací program z geografie pre nižšie stredné vzdelávanie. *Štátny pedagogický ústav* [cit. 2023-12-05]. Retrieved from: https://www.statpedu.sk/files/articles/dokumenty/inovovany-statny-vzdelavaci-program/geografia_nsv_2014.pdf.

ŠPÚ 2014b: Inovovaný Štátny vzdelávací program z vlastivedy pre primárne vzdelávanie. *Štátny pedagogický ústav* [cit. 2023-12-05]. Retrieved from: https://www.statpedu.sk/files/articles/dokumenty/inovovany-statny-vzdelavaci-program/prirodoveda_pv_2014.pdf.

TAYLOR, W., PLEWE, B. 2006: The effectiveness of interactive maps in secondary historical geography education. *Cartographic Perspectives*, (55), 16-33. DOI: https://doi.org/10.14714/CP55.325.

TYNER, J. A. 2014: *The world of maps: Map reading and interpretation for the 21st century*. New York (Guilford Publications).

UNLU, M. 2011: The Level of Realizing Geographical Skills in Geography Lessons. *Educational Sciences: Theory and Practice*, 11(4), 2166-2172.

UTAMI, W. S., ZAIN, I. M., SUMARMI 2018: Geography literacy can develop Geography skills for high school students: is it true? In Abadi, Mustofa, A., Wibawa, S. Ch. eds. *IOP Conference Series: Materials Science and Engineering*. Surabaya (IOP Publishing). DOI https://doi.org/10.1088/1757-899X/296/1/012032.

VAN DIJK, H., VAN DER SCHEE, J., TRIMP, H., VAN DER ZIJPP, T. 1994: Map skills and geographical knowledge. *International Research in Geographical & Environmental Education*, 3(1), 68-80. DOI: https://doi.org/10.1080/10382046.1994.9964928.

WANG, P. Y. 2013. Examining the Digital Divide between Rural and Urban Schools: Technology Availability, Teachers' Integration Level and Students' Perception. *Journal of Curriculum and Teaching*, 2(2), 127-139. DOI: http://dx.doi.org/10.5430/jct.v2n2p127.

WEEDEN, P. 1997: Learning through maps. In Tilbury, D., Williams, M. ed. *Teaching and learning geography*. London (Routledge Ltd.). DOI: https://doi.org/10.4324/9780203439050.

WIGGLESIVORTH, J. C. 2003: What is the best route? Route-finding strategies of middle school students using GIS. *Journal of Geography*, 102(6), 282-291. DOI: https://doi.org/10.1080/00221340308978560.

WOOD, R. M. 2023: A Review of Education differences in Urban and Rural Areas. *International Research Journal of Educational Research*, 14(2), 1-3. DOI: https://doi.org/10.14303/2141-5161.2023.254.

YALCINKAYA, E., KARACA, A. 2021: Examination of studies aimed at developing map skills in secondary school students: A meta-analysis. *Review of International Geographical Education Online*, 11(1), 236-261. DOI: https://doi.org/10.33403/rigeo.841330.

---

***Authors´ affiliation***

**Michael Fuchs**
Comenius University Bratislava
Faculty of Natural Science, Department of Didactics in Science, Psychology and Pedagogy
Ilkovičova 6, 84215 Bratislava
Slovakia
michael.fuchs@uniba.sk

**Elena Čipková**
Comenius University Bratislava
Faculty of Natural Science, Department of Didactics in Science, Psychology and Pedagogy
Ilkovičova 6, 842 15 Bratislava
Slovakia
elena.cipkova@uniba.sk

**Štefan Karolčík**
Comenius University Bratislava
Faculty of Natural Science, Department of Didactics in Science, Psychology and Pedagogy
Ilkovičova 6, 842 15 Bratislava
Slovakia
stefan.karolcik@uniba.sk

**Kristína Huszárová**
Comenius University Bratislava
Faculty of Natural Science, Department of Didactics in Science, Psychology and Pedagogy
Ilkovičova 6, 842 15 Bratislava
Slovakia
huszarova8@uniba.sk

**Jana Pčolová**
Elementary school with kindergarten
Bernolákova 1, 927 05 Šaľa
Slovakia
braunova3@uniba.sk