Developing pre-service teachers' preparedness for inquiry with digital mapping tools in geography

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Abstract: *Starting from the school year 2026/2027, Slovakia will implement the State educational programme for primary and lower secondary education (Ministry of education, 2023), introducing performance-based and content-related changes in geography education. For the third educational cycle (6^{th} –9^{th} grades) the curriculum sets learning activities that can be conducted using geoinformation technologies. These activities include geographical inquiry, the use of statistical data for acquiring, processing, presenting the information, identifying the spatial relationships, creating a map, and drawing conclusions. The achievement of such educational goals may vary depending on the understanding and preparedness of teachers. In this context, it is essential that future geography teachers acquire the knowledge and skills to apply inquiry-based teaching strategies effectively. This paper examines inquiry-based learning and teaching with digital mapping tools aimed at pre-service geography teachers by equipping them to design their own inquiry-based tasks. A set of twenty-eight geography tasks was analysed from didactic and subject-specific viewpoints. Findings show pre-service geography teachers cultivated their expertise in understanding and designing the inquiry-based tasks with the use of selected digital mapping tools in topics of school geography. Their most frequent design was a task to create a thematic map representing a demographic indicator of Slovak population using the ArcGIS Online platform. The study concludes with recommendations for integrating inquiry-based learning with digital mapping tools into geography teacher training programmes.*

Keywords: *digital mapping tool, geography, inquiry-based learning, pre-service teacher, Slovakia, State Educational Programme*

Introduction

Slovakia follows a two-tier education system. At the national level, there is an innovated State Educational Programme (Ministry of Education 2015), providing a frame for each school to adapt it into School Educational Programme. The curriculum is a dynamic document and over some years it is a subject to revision. Rehúš (2018) analysed the curriculum for primary schools and identified Slovakia is a country having a high degree of prescription and detail in the national curriculum. He stated that the content was overly focused on theoretical and encyclopaedic knowledge (f. ex. to classify the islands of Australia or to identify the most important economic sectors of Australia), and recommended a greater emphasis on developing inquiry skills. The most recent report by the State School Inspectorate (2024) indicated transmissive instruction still dominated in Slovak schools, with a predominant focus on delivering information in a ready-made form, which did not foster active learning. Inquiry-based learning (IBL) was largely absent, and teachers implemented only a limited number of activities aimed at developing analytical thinking, evaluation skills, self-assessment, creativity, and critical thinking. The new State Educational Programme for Primary and Lower Secondary Education (Ministry of Education 2023), which will become mandatory for all schools providing primary education from the first grade in the school year 2026/2027, is expected to bring changes into teaching practice towards more student-centred approaches, active learning and greater student engagement (Ministry of Education 2022).

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In Slovakia, geography is currently a standing alone subject within the educational area Man and Society together with history and civics. The time allocation for geography in the lower secondary level (5th–9th grades) is set at six lessons for the entire level of education: two lessons per week for the 5th grade and one lesson per week for the 6th–9th grades. In secondary grammar schools, geography is allocated four lessons for the entire secondary education. In the State Educational Programme for Primary Education (Ministry of Education 2023) geography remains in the same educational area yet introducing an option for partially or fully integrated subject Man and Society (integrating geography, history, and civics) with a predefined time allocation. Geography education is undergoing a significant change, its curriculum will shift from the traditional regional geographies towards stronger emphasis on thematic geography. Regarding teaching methods, the focus will move away from rote memorization of isolated facts and place greater emphasis on inquiry-based learning methods (Farárik 2023). In terms of activities, new geography curriculum introduces new types of tasks, for example, in the third educational cycle (6th–9th grades), students learn geographical fieldwork, thematic map creation, using statistical data for data acquisition, processing and presentation, identifying spatial relationships and drawing conclusions. These activities are encouraged to be achieved with geoinformation technologies throughout the entire educational cycle (Ministry of Education 2023). Learning by activities in which students take an active role constructs their own knowledge and creates constructivist learning environments. Such environments are popular in teaching but it is necessary to ensure that lessons are not only focused on the process of learning, but also the content of learning (Kirscher et al. 2006). A constructivist educational strategy as a valuable approach to geography education is inquiry or inquiry-based learning (Jong et al. 2023). If teachers and pre-service teachers want to employ such environments, they should experience, apply, and evaluate them beforehand and it seems to be a challenge for teacher training programmes to improve pre-service science teachers' inquiry-based instructional activity design competency (Long et al. 2024).

This paper deals with preparedness of pre-service teachers for implementing IBL in geography education by analysing the inquiry tasks they design. Through the analysis of their works, we seek to determine how well they understand inquiry-based approaches and how effective it is for them to design the inquiry-based tasks. This study examines the following research questions:

1. What characteristics should an inquiry-based task in geography have?
2. What characteristics do inquiry-based geography tasks with digital mapping tools designed by pre-service teachers have?
3. Does a training course have an impact for pre-service teachers in developing geo-inquiry with digital mapping tools?

Theoretical background

Inquiry-Based Learning in Geography

For more than a decade, IBL has been introduced as a teaching method particularly in science education at primary and secondary schools in Slovakia. The idea of IBL was initially aligned with the effort to increase students' interest in studying science subjects (Rocard et al. 2007). However, in recent years, it has also been addressed in social science subjects. This approach, which simulates the work of scientists, is based on relatively independent student inquiry through their active engagement in a step-by-step process. Despite subject-specific differences, educators generally agree that the key stages of IBL include problem formulation, planning, implementation, conclusion, and presentation (Csachová et al. 2022). To be able to do inquiry, students have to develop specific skills essential for scientific investigation (Lukáč et al. 2016, Kireš et al. 2016). The current situation with IBL in Slovakia is that although many

schools have the necessary equipment and resources for implementing it, its application remains very limited (State School Inspectorate, 2024). The increasing relevance of IBL in education witnesses the fact that in the 2024/2025 school year, the National Institute of Education and Youth (2024) is offering professional development events for teachers specifically devoted to this instructional approach.

It can be assumed that IBL has been established and is, in some form, being implemented also in geography education. Although mapping, spatial analysis, and geovisualization are more accessible than ever before (Fargher 2018), the use of geographic data, digital maps, and the creation of maps remain relatively rare at schools. Inquiry-based geography lessons are included only occasionally, often as isolated activities or as a reward (Csachová 2021), however, research findings by Vilinová et al. (2021) emphasize the need for the iterative inclusion of inquiry-based activities to ensure the effectiveness of the entire learning strategy. IBL has a generally positive impact on students' learning in geography (Demirci 2015, Solari et al. 2015), yet its integrating into teaching practice is not straightforward. Among several challenges that hinder its implementation belong limited experience, fear of failure, demanding lesson preparation, doubts about its effectiveness, and lack of teaching resources (Romero-Ariza et al. 2020). In Slovakia, Karolčík and Čipková (2015), Škodová and Turošíková (2020), Karolčík and Csachová (2021), Csachová et al. (2020), Ondová et al. (2020), and Tomčíková (2021) have worked out units of IBL for geography teaching and learning. Their works provide geography teachers with solid essentials for implementing IBL.

A geographer uses the knowledge, skills, attitudes to explore the world scientifically and the final product of their research is usually graphically or cartographically visualized. In educational contexts, interesting and real-life topics are eligible for inquiry in geography education. Such tasks enhance students' subject-specific knowledge and skills as using geographic concepts, searching for sources, analysing data, visualizing findings, and providing explanations. The process of inquiry in geography, known as geo-inquiry process is suggested by Love (2017), Chaffer (2022), and Csachová et al. (2022). The authors recommend its implementation as a series of three or five sequential steps (tab. 1).

Tab. 1. *Models of the geo-inquiry process in geography*

Model 3	Model 5
Acquiring geographic information	Formulating a geographic question
Processing geographic information	Gathering information from relevant sources
Communicating geographic information	Processing geographic data
	Analyzing geographic information
	Presenting, sharing, and discussing results

Source: Love (2017), Chaffer (2022), Csachová et al. (2022)

The geo-inquiry process begins with posing a geographic question, either by the teacher or the students. In order to raise students´ curiosity and engage their thinking, they reflect on what is essential about the question from a geographical perspective. Then they consider what information from primary and/or secondary sources they need to gather in order to answer the question and proceed to collect data from these sources. In the next step, students systematically process and visualize the data, they decide what type of visualization (type of chart or thematic mapping methods) is most appropriate for displaying a particular indicator. Once the data are visually represented, they analyse relationships, trends, spatial and temporal patterns, and connections between the studied phenomena. Students follow with answering the initial question and formulate conclusions. Finally, they present and share their findings, most commonly with their classmates.

Pre-service Teachers and Teachers in Inquiry-Based Teaching Research

Pre-service and in-service teachers are often a subject of research studies examining their engagement with IBL. Their preparedness for selected aspects of inquiry-based teaching is most commonly explored using quantitative research methods, lesser qualitative methods, or a combination of both. The role of prior experience with IBL is studied by Fazio et al. (2010, n=107) and Silm et al. (2017) who found that teachers who had experienced inquiry during their studies were more likely to integrate it into their teaching practice. Taking such course during undergraduate studies or as a professional development programme was a milestone to start innovative teaching concepts. Training in IBL with chemistry pre-service teachers in Sotáková et al. (2017, n=57) and with technical education pre-service teachers in Kožuchová and Severini (2023, n=52) improved their understanding of its principles. Intervention with pre-service science teachers that substantially improved students´ competence to design an inquiry-based lab was addressed in Mugaloglu and Saribas (2010).

In-service teachers are enthusiastic about the IBL in a study by Tkáčová (2019, n=1173) as she states more than 90 % of primary and secondary school teachers believe that IBL is suitable for their subjects and feasible within their schools. However, most respondents stated they would be able to implement well-prepared inquiry-based teaching materials, while only 11 % of teachers felt confident in designing their own materials. Tomčíková (2021, n=116) surveyed geography teachers on IBL and found that one of the reasons they did not implement IBL more often may be they it is not supported in the curriculum, they do not feel comfortable and self-confident with it because not having had necessary competencies. They additionally think students feel uncertain with inquiry because they are accustomed to follow teacher direct instructions. Through content analysis of students´ designs a study by Vojteková et al. (2021, n=42) examined how geography pre-service teachers created story maps (using Knight Lab – Story Map JS, Esri – ArcGIS Story Map, and Google – Tour Builder) during the COVID-19 pandemic, despite not having had prior experience with these applications.

We assume that the development of IBL among pre-service teachers can be assessed not only quantitatively, but also qualitatively by analysing the design of inquiry-based learning tasks they create themselves. By designing their own instructional vision, pre-service teachers demonstrate their understanding of IBL as well as their ability to apply it in their practice.

Inquiry with digital mapping tools

IBL in geography is closely associated with the use of geospatial technologies (Csachová et al. 2022, Lee 2023, Mašterová 2023, Rubino-Hare et al. 2024). We evaluated several digital mapping tools (designed for wide public) that can be assumably applied in educational contexts in school geography and presented them to pre-service teachers (tab. 2). The criteria for having selected them was a tool was free of charge to students, attractive user interface, visualisation options, thematic cartographic methods, and saving and sharing an image. A simpler digital tool for choropleth mapping is MapChart (https://www.mapchart.net/). It works by colouring predefined areas, regardless of the nature of the data, making it suitable for basic map visualizations for beginners. The tool is particularly well-suited with lower grades of lower secondary school students. Google Maps (https://www.google.com/maps) is a digital mapping tool used for browsing maps, finding routes, and basic geographic analysis of selected locations. It is user-friendly, free, and suitable for geographic inquiry and seemingly well suited for lower secondary school students. Google Earth (https://earth.google.com/web) is a more advanced digital tool offering a wide range of functionalities (exploring the Earth's surface, viewing historical maps, 3D modelling, or designing custom routes). The tool allows for grading levels of complexity, making it more suitable for upper grades of lower secondary school students. One

of the most widely used platforms in geographic studies analysing spatial data and creating interactive maps in educational contexts is ArcGIS Online (https://www.arcgis.com) (Kholoshyn et al. 2019, Gábor 2022). It requires basic skills of geographic information systems (GIS) and allows map creation in a free version without user registration, albeit with limited functionality. Dozens of short, pre-built inquiry-based activities using ArcGIS Online are designed as Geoinquiries (Baker 2015). This platform appears to be suitable for higher secondary school students. Datawrapper (https://www.datawrapper.de/) is a versatile tool for creating both cartographic and statistical visualizations. Its user-friendly and intuitive interface allows for effective data processing, visualization, interpretation, and sharing. However, it requires some prior experience with data visualization, and is seemingly more suitable for upper grades of primary and secondary school students.

Tab. 2. *Comparison of selected digital mapping tools for educational use*

Tool	Free access	User-friendliness	Cartographic visualization options	Data upload	Output export	Notes
MapChart	✓	very intuitive	choropleth maps (predefined regions)	x	.png	for beginners
Google Maps	✓	very intuitive	none	x	screenshot	navigation & local tasks
Google Earth	✓	moderate	point symbols (pins)	x	.kmz, screenshot	interactive tasks
ArcGIS Online	✓ (limited)	less intuitive	choropleth maps, proportional symbol maps (charts), point/line/polygon symbols, categorical symbology	✓	web shared map, screenshot	most advanced
Datawrapper	✓	intuitive	choropleth maps, proportional symbol maps, location maps	✓	.png, embed code, .pdf	best for data visualization

Source: own processing

Methodology

Pre-service teachers were requested to design an inquiry-based learning task related to school geography, using a selected digital mapping tool and to teach it within a 20-minute microteaching session. Before microteaching session, a pre-service teacher could have a consultation with a tutor to discuss their instructional design. Microteaching was conducted following the approach by Csachová (2019). One pre-service teacher was in a role of a teacher, the others were in the role of students. Students were introduced with the topic, worked on the inquiry tasks and used the digital mapping tools. At the end of the semester, pre-service teachers submitted their assignments in a form of a lesson plan. Each submission represented one authentic inquiry-based learning task designed and taught by one pre-service teacher. Then we analysed them according to the following criteria:

1. Educational goal – The task's goal was classified according to the revised Bloom's taxonomy of cognitive goals in terms of knowledge (factual, conceptual, procedural, and metacognitive) and cognitive process (remembering, understanding, applying, analysing, evaluating, and creating) (Krathwohl 2002, Csachová 2016).
2. Subject-specific content – Pre-service teachers design their investigative task on a content they could freely choose from geography curriculum. Each task was then categorized into a subject-specific area of scientific geography (physical geography, human geography, world regional geography, physical geography of Slovakia, human geography of Slovakia, and world global issues).

3. Geo-inquiry question – A question posed by students aimed at main issue they will explore through a geographic lens. It asks where things are and how they are connected to other things spatially and why that is important (Love 2017). According to semantic notion of questions and expected answers they were classified into categories based on eight modes of spatial thinking (comparison, aura, region, hierarchy, transition, analogy, pattern, association) as developed by Gersmehl and Gersmehl (2007) and Gersmehl (2014, 2023).
4. Data source – The types of data sources, as well as the methods used to present and communicate these data to students were assessed.
5. Visualization – The type of visualization output (a map, table, graph, diagram, or image) assigned to students was evaluated. Additionally, the pre-service teachers' approach for assessing the quality of these visualizations were touched.

Data

The research was conducted during the 2021/2022, 2022/2023, and 2023/2024 academic years with pre-service teachers at the Institute of Geography, Faculty of Science, Pavol Jozef Šafárik University in Košice. During Didactics of Geography course, pre-service teachers were introduced IBL in geography education. In the courses of Seminar from Geography Didactics and New Trends in Geography Teaching, a space was geared to inquiry with digital mapping tools. This analysis includes those pre-service teachers designed inquiry-based tasks that included using Google Earth, Datawrapper, ArcGIS Online, and open data sources, either independently or in combination with MS Office (Excel or PowerPoint). The final dataset comprised 28 learning tasks: 4 tasks in Google Earth, 11 tasks in ArcGIS Online, 10 tasks in Datawrapper, and 3 activities using open data sources (tab. 3).

Tab. 3. *Distribution of inquiry-based tasks across digital mapping environments by academic year*

School year	Number	Google Earth	ArcGIS Online	Datawrapper	Open Data
2021/2022	7	-	4	3	-
2022/2023	7	-	3	3	1
2023/2024	14	4	4	4	2
Total	28	4	11	10	3

Source: own processing

Results

When defining the educational goals, pre-service teachers often did not state them in a single sentence but provided multiple sub-goals. Consequently, each stated learning goal was categorized according to the revised Bloom's taxonomy of cognitive goals. The analysis revealed a strong dominance of conceptual and procedural learning goals. Conceptual goals were primarily focused on understanding concepts (when acquiring geographic data), identifying relationships and connections between them, and forming generalizations (when analysing geographic data). Procedural goals were most dominant, particularly when processing data, because students were to consider an appropriate cartographic approach and selected a thematic mapping method. The findings overall suggest that pre-service teachers designed learning tasks supported the development of higher cognitive levels of knowledge. This aligns with the findings of Antonio and Prudente (2024), who concluded that inquiry-based teaching approaches have a significant and positive impact on the development of students´ higher-order thinking skills.

With regard to content, a strong dominance of human geography of Slovakia, particularly topics related to population geography could be observed. In contrast, world regional geography, physical geography, and human geography were significantly less represented. The category of world global issues, which bridges both physical and human geography, also had a lower representation. In one instance, pre-service teacher chose topic focused on thematic mapping methods (tab. 4). It brings us to know that pre-service teachers perceive IBL as most applicable to demographic topics within the national context. This preference may be likely due to the dynamic nature of demographic phenomena evolving over time and space, local and well-known context as well as good data availability.

Tab. 4. *Subject-specific content of inquiry-based learning tasks designed by pre-service teachers*

PG	HG	PG Slovakia	HG Slovakia	World regional geography	World Global Problems	Geography in practice
-	4	1	15	4	3	1

Source: own processing

Geo-inquiry questions were analysed with the modes of spatial thinking (Gersmehl and Gersmehl 2007). Similarly, Trahorsch and Knecht (2021) used taxonomy of learning tasks according to spatial thinking in research of geography textbook questions. In some cases, assigning a question to a specific mode of spatial thinking was straightforward, however, in other cases, the way the inquiry question was formulated allowed for implication into more categories. In such instances, we considered educational goal, the intended answer and the way they were posed to students during the microteaching session. The analysis of 30 geo-inquiry questions revealed that all questions were open-ended and geographically contextual. The most common types of inquiry questions focused on comparison, spatial arrangement, and change over time and space. Fewer questions were related to impact, relationships, movement, and place (tab. 5).

Tab. 5. *Geo-inquiry questions based on modes of spatial thinking*

Mode of spatial thinking	Example
Comparison	What is the current state of natality and mortality worldwide?
Influence	What are the consequences of global warming to icebergs and islands?
Spatial pattern	Which districts of Slovakia are mostly affected by population ageing?
Change in time and space	How have been mining localities changing over time and space?
Association	What are the current problems of the Prešovský self-governing region and what kind of subsidy does it need?
Movement	What is the current state and perspective of domestic and international transport in Australia?
Region	Which volcanoes account for the Ring of Fire and what is their current volcanic activity?

Source: own processing

The selection of data sources analogically corresponded to the selection of subject-specific content. Pre-service teachers most frequently opted for data from the Statistical Office of the Slovak Republic. In some cases, data sources included Eurostat, the United Nations, Worldometer, and a transportation-related database. In other cases, data sources were not specified, or no data were used (tab. 6). The step of data processing was not duly realized during the microteaching sessions due to time constraints. Instead, students were provided ready-

made datasets (further in the Limitations section). On the whole, the selection of data sources can be considered credible and appropriate for geography education.

Tab. 6. *Data sources in inquiry-based learning tasks created by pre-service teachers*

Statistical Office SR	Open Data	Eurostat	WPP UN	Other internet sources	Bureau of Infrastructure and Transport Research Economics	Not stated	No data used	Worldmeter
14	3	1	1	1	1	3	3	1

Source: own processing

The visualization products varied depending on the mapping digital tool used. Google Earth tasks headed to creating a virtual tour or a series of slides, with one case incorporating an Excel table. Using ArcGIS Online, similarly to Datawrapper, tasks were primarily aimed at generating thematic maps using choropleths. When using open data sources, students processed data in MS Excel (producing graphs) or in ArcGIS Online (producing maps). In a few cases, students selected a poster as the final product of their activity (tab. 7).

Tab. 7. *Types of visualization products in inquiry-based learning tasks created by pre-service teachers*

Google Earth	ArcGIS Online	Datawrapper	Open Data
Virtual tour (.kmz), slide (.pptx), chart (.xlsx)	map (choropleth)	map (choropleth)	graph, poster

Source: own processing

Discussion

The reform of primary and lower secondary education in Slovakia (Ministry of Education 2023) is about to bring significant changes in teaching approaches. Geography teachers are anticipated to refine their teaching methods and work with students in more active ways. But are our teachers ready to engage students in conducting research, working with reliable sources of data, evaluating statistical information, and creating thematic maps? These learning goals seem to be suitably achieved with IBL, but do teachers have the skills to design quality inquiry-based tasks for their students? This paper aims to answer this question.

Over the course of three academic years, we investigated geography pre-service teachers' preparedness for inquiry-based learning and teaching during didactics courses. The research object was an analysis of 28 inquiry-based tasks created by geography pre-service teachers. Initially, pre-service teachers were introduced with IBL, the framework of the geo-inquiry process, and examples of inquiry-based tasks in geography. One of their assignments was to design a geographic inquiry-based task using a digital mapping tool. Pre-service teachers then implemented their designs through microteaching sessions. It can be stated that learning tasks supported the development of higher levels of cognitive hierarchy. They set inquiry questions that were open-ended, dynamic, engaging and having a geographical perspective. In terms of content, a strong preference for population geography of Slovakia could be noticed. The dominant types of geo-inquiry questions focused on comparison, spatial arrangement, and changes over time and space. Students most frequently worked with data from the Statistical Office of the Slovak Republic. The most widely used digital mapping platform was ArcGIS Online, which has strong educational support in studies by Kerski (2014), Baker (2015), and Hong and Melville (2017), but in the study of Vilinová et al. (2021) the ArcGIS platform was the least preferred option by pre-service students for creating story maps. The most common

type of inquiry-based task pre-service teachers developed involved an inquiry question focused on the spatial distribution of a selected demographic indicator, which was then visualized as a thematic map using the ArcGIS Online platform.

Good practice

We discuss three examples of good practice which show pre-service teachers were able to design and instruct inquiry-based tasks the educational goal of which was to create a thematic map using a digital mapping tool. The figure 1 shows the examples of such outputs. These maps were created by the pre-service teachers as a part of their lesson plan and serve for illustration as examples of expected goal. Most of the microteaching was instructed in a way that students created the maps individually or in pairs, with a pre-service teacher´s due guidance.

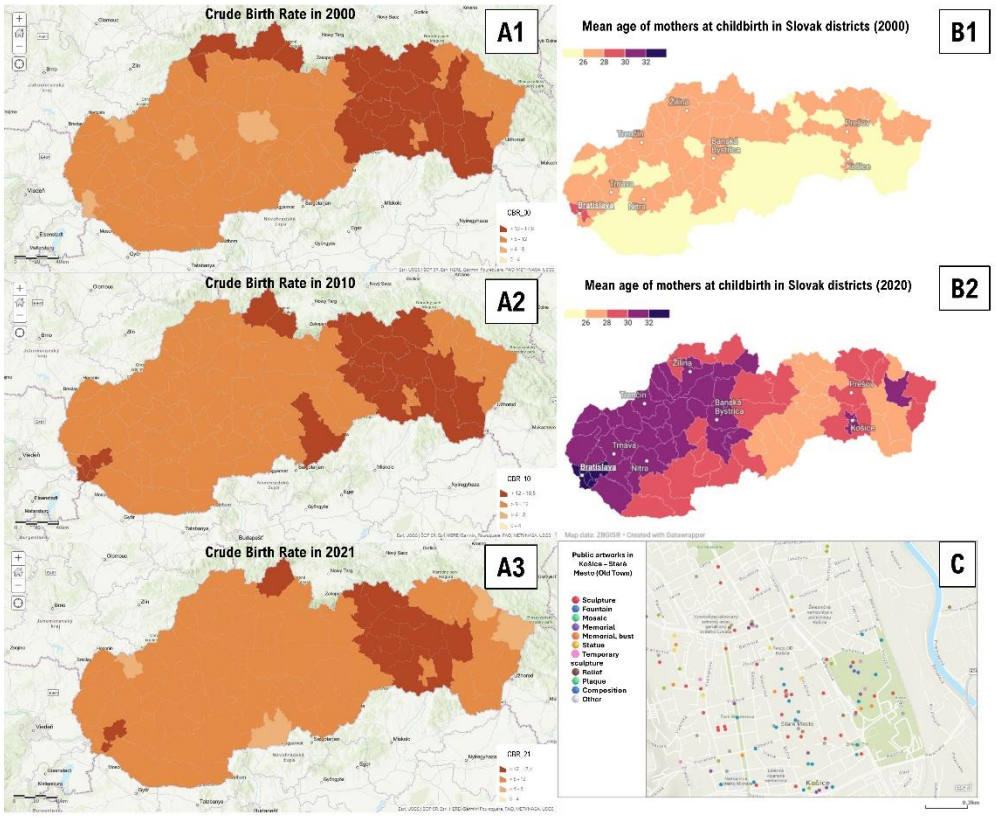

Fig. 1. *Examples of good practice in designing inquiry-based geography tasks*
Source: pre-service teachers´ works (anonymous), own processing

A1, A2, A3: platform ArcGIS Online. Question: How has the birth rate changed in districts over the past 20 years? Indicator: crude birth rate. Region: districts of Slovakia. Period: 2000, 2010, 2021. Note: appropriate selection of thematic mapping method (choropleth map), number of intervals, range of intervals, length of the period for process comparison.

B1, B2: platform Datawrapper. Question: How has the average age of mothers at childbirth changed in districts of Slovakia over the past 20 years? Indicator: average age of mothers at childbirth. Region: districts of Slovakia. Period: 2000, 2020. Note: appropriate selection thematic mapping method (choropleth map), number of intervals, range of intervals, length of the time period for process comparison.

C: Open data + platform ArcGIS Online. Question: Which tourism landmarks in the city of Košice are listed as UNESCO heritage sites and why? Indicator: tourism landmarks. Region: selected urban district of Košice. Note: appropriate processing of data from the Open Data Košice portal and visualizing categories of tourism landmarks using a location map.

Inaccuracies

We discuss three examples of inquiry task designs that pre-service teachers´ instructed and involved some subject-specific (usually cartographic) inaccuracies. They were identified either during consultations before microteaching (a pre-service teacher revised it afterwards and instructed it correctly) or as feedback after microteaching. Pre-service teachers´ works are presented in figure 2.

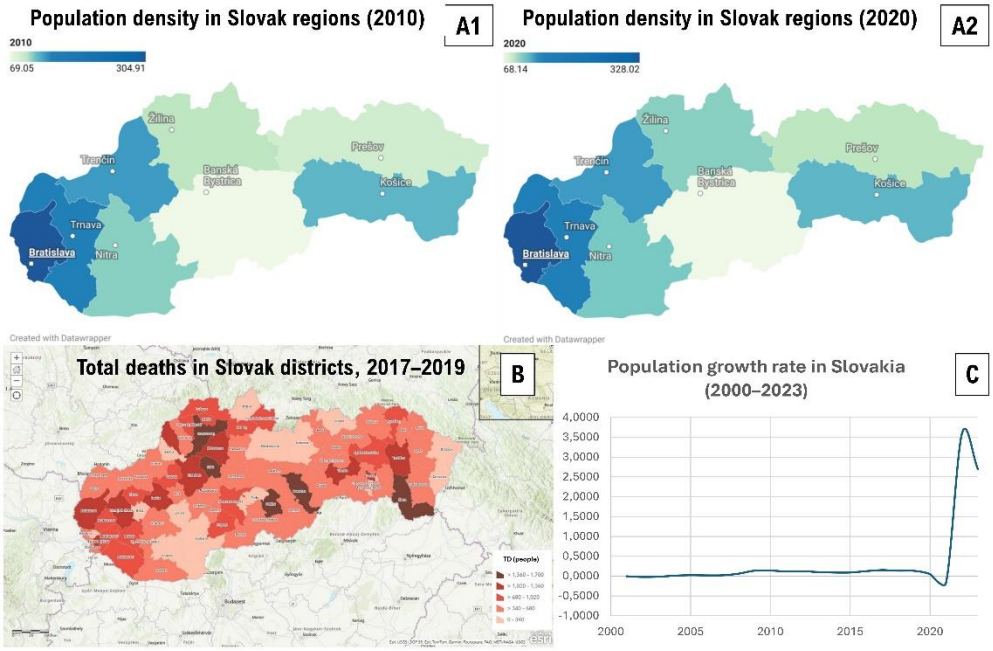

Fig. 2. *Examples of inaccuracies in designing inquiry-based geography tasks*
Source: pre-service teachers´ works (anonymous), own processing

A1, A2: Datawrapper platform. Question: How has population density changed in the regions of Slovakia over the past ten years? Indicator: population density (inhabitants per km²). Region: regions of Slovakia. Period: 2010, 2020. Note: From our perspective, this indicator is not suitable for being searched at the regional level since it is relatively stable over time, making the resulting map less effective for interpreting this indicator. During the consultation, the tutor recommended reconsidering the choice of the indicator, yet the pre-service teacher insisted on using it, and the microteaching session was conducted accordingly.

B: ArcGIS Online platform. Question: Which districts of Slovakia recorded high mortality rates between 2017 and 2019? Indicator: number of deaths (absolute values). Region: districts of Slovakia. Period: 2017–2019. Note: The issue concerns the selection of an appropriate thematic mapping method to answer the inquiry question. The task was based on visualizing absolute numbers of deaths using a choropleth map, which is methodologically incorrect.

C: Work with MS Excel. Question: What is the annual population growth rate in selected countries worldwide and in Slovakia? The pre-service teacher designed the activity in which

students observe changes in the population of a selected country at 5-minute intervals on www.worldometers.info and use these data to calculate the annual population growth rate. During the consultation, the student was recommended that this approach appeared statistically irrelevant, as short-term fluctuations in population cannot be extrapolated to an annual level. This flawed methodological setup caused extreme fluctuations in the graph of Slovakia's population growth rate, which did not correspond to the current demographic situation. Another shortcoming was comparing the results with calculated values from the mentioned website. The misleading data usage and the inadequately data processing procedure led to redesign.

Being aware of the fact the IBL training provided to pre-service teachers was conducted in a simplified and accelerated format, they underwent a complex process – the essentials of IBL, design, consultation, implementation, microteaching, and evaluation. We consider this structured process a valid contribution to developing the inquiry-based teaching skills among future geography teachers. Overall, it can be stated that pre-service teachers are prepared to implement IBL in their teaching, although the quality of their inquiry tasks varied. Among their stronger competencies, pre-service teachers demonstrated the ability to plan inquiry activities, work with various digital mapping tools, understand the role of spatial analysis in geography through questioning, and utilize different data sources. Over time, they gained greater confidence in applying inquiry-based approaches. Certain weaknesses were also identified. Some logical and stylistic shortcomings in formulating inquiry questions and cartographic inaccuracies in the visualization process were registered.

Limitations

We have identified several limitations of this study. The first was lack of time meaning a short duration of the microteaching session that allowed to simulate only a part of a lesson. Inquiry-based learning and teaching typically extends beyond a single lesson and for its effective implementation it requires more time. Given the syllabus and the number of pre-service teachers, it was not possible to allocate additional time. Further limitation was that there was usually limited space for reflection during microteaching sessions. A pre-service teacher was delivered a heap of students´ assignments and students did not receive feedback to them by the end of the lesson (due to lack of time again). Another limitation may be a small-scale character of this study, even though it included all pre-service teachers who enrolled the course and met the selection criteria for the study.

Conclusion

Teachers are key actors in education, and much depends on their perceptions of curriculum and their willingness to adapt and enhance it for their students (Kosová 2017). They necessarily need to think about the curriculum, identify what content is, what educational potential content has, and how content can be made to open up opportunities for students (Deng 2018). Teachers´ motivation, personal experiences, beliefs, and preparedness for curricular changes makes up a set of factors that directly influence their teaching practices.

Learning tasks serve as a tool for guiding instruction and engaging students, giving them meaningful learning experiences. The teachers´ design of learning tasks is a creative process that reflects their expertise, skills, and mirrors the educational standards, such as curricular requirements or specific learning goals. The study´s aim was to consider pre-service teachers' preparedness for inquiry-based learning through the analysis of their design of inquiry-based tasks. A sum of twenty-eight learning tasks was analysed from didactic and geographic viewpoints. The tasks designed by pre-service teachers corresponded with the framework of inquiry-based geography learning and teaching. They included open-ended, real-life inquiry questions, data collection, graphical data representation, analysis, presentation and communication of the results. The tasks also encouraged the use of digital tools, particularly online

mapping platforms. It is implied from the findings that pre-service geography teachers demonstrated preparedness for IBL in school geography using selected digital mapping tools. Their most frequent option was the creation of a thematic map visualizing a demographic indicator of Slovak population using the ArcGIS Online platform. In the light of what has been addressed, we offer some recommendations:

- The trend in Slovak geography education is shifting away from rote memorization towards exploring and explaining spatial relationships (Farárik 2023). The activities to be executed in the third cycle of the geography curriculum (Ministry of Education 2023) are suggested in a way they can be effectively implemented through IBL.
- In doing so, pre-service teachers should experience IBL during training courses because then they are more likely to implement it in their own teaching practice.
- It is recommended the inquiry-based learning task in geography follow the geo-inquiry process, allowing students to simulate the work of a geographer-scientist and produce a visual representation of the analysed data.
- Teachers practising IBL can design inquiry-based tasks respecting balanced representation of topics from all kinds of geographies (physical, human and regional geographies) and different scales (local, regional, world).
- In terms of visualization, teachers can design tasks integrating various methods of graphical and thematic mapping methods to develop spatial understanding.

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