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Geographic Literacy and Spatial Thinking Among Primary School Teachers in Serbia

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ABSTRACT

Geographic literacy and spatial thinking are essential competencies for teaching Nature and Society (Priroda i društvo) in Serbian primary education, yet the level of these competencies among primary school teachers remains largely unexplored. This cross-sectional survey study investigated self-assessed geographic competencies, spatial thinking practices, and geographic knowledge among 206 primary school teachers across five regions of Serbia. Data were collected using a structured questionnaire comprising three sections: a self-assessment scale on geographic competencies (8 items, $\alpha = .645$), a spatial thinking practices scale (10 items, $\alpha = .416$), and a geographic knowledge test (8 items). Analyses included descriptive statistics, independent samples t-tests, and one-way ANOVA. Teachers reported moderate levels of geographic competency ($M = 3.66$, $SD = 0.54$). Those who had completed geography courses during their university studies scored significantly higher on all three measures ($p < .01$). Spatial thinking practices differed significantly by teaching experience ($F = 5.296$, $p = .002$), with teachers having over 25 years of experience reporting the lowest levels. Only 25.0% of respondents reported regular use of geospatial tools such as Google Earth. The knowledge test revealed uneven performance, with particularly low scores on altitude classification (17.0% correct) and map scale interpretation (56.5% correct). These results suggest that quantitative and classification-based geographic concepts may warrant greater attention in teacher preparation. However, the convenience sampling, overrepresentation of one region, and modest reliability of the spatial thinking scale limit the generalizability of the findings. Implications for teacher education and professional development are discussed.

Keywords: geographic literacy; spatial thinking, primary education; Nature and Society; Serbia; teacher competencies

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Introduction

Geographic literacy, broadly defined as the ability to use geographic understanding and reasoning to make informed decisions about daily life and global issues (Edelson, 2012), represents a fundamental component of primary education. In Serbia, geographic content constitutes a significant portion of the Nature and Society (Priroda i društvo) curriculum taught in grades 3 and 4, as well as the World Around Us (Svet oko nas) curriculum in grades 1 and 2 (Ministarstvo prosvete, 2019). These subjects introduce young learners to key geographic concepts including spatial orientation, landscape features, climate, hydrography, and human-environment interactions.

Despite the importance of geographic content in primary education, research on the geographic literacy of primary school teachers in Serbia is notably scarce. International studies have shown that primary teachers often have limited geographic subject knowledge and low confidence in teaching geography (Catling, 2004; Catling & Morley, 2013; Preston, 2015), yet the existing body of literature in Serbia has primarily focused on secondary school geography teaching (Ivkov-Džigurski et al., 2019; Stojšić et al., 2019) and active teaching methods in geography classes (Lukić et al., 2016). Primary school teachers' geographic competencies remain an underexplored area in the Serbian context.

This gap is particularly significant because primary school teachers in Serbia are generalist educators responsible for teaching all subjects, including Nature and Society. Unlike secondary school geography teachers who hold specialized degrees, primary school teachers are trained at faculties of education (učiteljski fakulteti), where geographic content represents only a fraction of the curriculum (Šaćirović & Bratić, 2021). This raises concerns about the depth of geographic knowledge these teachers possess and their capacity to convey geographic concepts effectively.

Spatial thinking, a core component of geographic literacy, is widely recognized as a cognitive skill that supports learning across disciplines (National Research Council, 2006; Newcombe, 2010; Uttal et al., 2013). Geospatial technologies such as GIS, Google Earth, and digital mapping platforms offer promising avenues for enhancing geographic literacy in educational settings (Baker et al., 2015; Kerski, 2015; Patterson, 2007), yet the extent to which Serbian primary school teachers use these tools remains unknown.

Recent studies from the broader region have highlighted concerns about geographic literacy levels among both students and teachers. Lešćešen et al. (2024), in a study published in this journal, found significant gaps in climate change knowledge among primary school students in Serbia, suggesting potential shortcomings in how geographic content is taught. Similarly, Stojšić et al. (2019) examined the readiness of geography teachers to use mobile devices and immersive technologies, highlighting the importance of technological competencies in geographic education.

The purpose of this study is to: (1) assess the self-reported geographic competencies of primary school teachers in Serbia, (2) examine the extent to which spatial thinking practices are incorporated into Nature and Society teaching, (3) evaluate the use of geographic tools and geospatial technologies in primary education, and (4) identify factors (teaching experience, school location, geographic education background) that influence teachers' geographic literacy levels. The findings are expected to provide empirical evidence for improving teacher education curricula and professional development programs at Serbian faculties of education.

Theoretical Framework

Geographic Literacy in Primary Education

Geographic literacy encompasses three interrelated dimensions: geographic knowledge, geographic skills, and geographic dispositions (Heffron & Downs, 2012). Geographic knowledge includes factual information about places, regions, and spatial patterns. Geographic skills involve the ability to ask geographic questions, acquire geographic information, organize and analyze data, and communicate findings. Geographic dispositions reflect attitudes toward geography and a commitment to applying geographic thinking in everyday life. In the present study, geographic literacy is understood as a composite of these three dimensions and is operationalized through teachers' self-assessed competencies (Section A), their reported spatial thinking practices (Section B), and their performance on a curriculum-aligned knowledge test (Section C). This approach allows for a multi-faceted assessment that captures both perceived and demonstrated aspects of teachers' geographic literacy.

In the Serbian educational context, the Nature and Society curriculum integrates geographic content with elements of biology, ecology, history, and civic education (Ministarstvo prosvete, 2019). The geographic components include: orientation in space and time, natural characteristics of the homeland (relief, climate, hydrography), population and settlements, and human-environment relationships. Teachers are expected to facilitate students' understanding of these concepts through both theoretical instruction and practical field activities.

Spatial Thinking and the TPACK Framework

Spatial thinking refers to a set of cognitive skills that involve understanding the meaning of space, using properties of space to frame problems, and reasoning with

spatial representations such as maps, diagrams, and models (National Research Council, 2006). In an educational context, spatial thinking practices encompass the range of teaching activities through which teachers promote students' spatial reasoning — including the use of maps and atlases, orientation exercises, fieldwork, digital geospatial tools, and tasks that require students to represent spatial relationships (Gersmehl, 2014; Jo & Bednarz, 2009; Newcombe, 2010). In the present study, spatial thinking practices are operationally defined as the self-reported frequency with which teachers employ such activities in the teaching of Nature and Society content (see Section B of the instrument and Table 3).

The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) provides a useful lens for examining how teachers integrate geographic content knowledge with pedagogical approaches and technological tools. TPACK posits that effective teaching requires the intersection of content, pedagogical, and technological knowledge — a perspective particularly relevant for primary school teachers who must make abstract geographic concepts accessible to young learners using age-appropriate methods and tools (Milson et al., 2012).

Teacher Competency and Professional Development

Research consistently demonstrates that teacher content knowledge significantly impacts student achievement (Hill et al., 2005; Shulman, 1986). In the field of geography education, studies have shown that teachers with stronger geographic content knowledge are more likely to employ inquiry-based and student-centered pedagogical approaches (Lane & Bourke, 2019). Conversely, teachers with limited geographic knowledge tend to rely heavily on textbook-based instruction and lecture methods (Preston, 2015).

The professional development of primary school teachers in geographic content has received increasing attention in the international literature. Gersmehl (2014) argued that effective geographic education requires teachers who can think spatially and model spatial reasoning for their students. This perspective aligns with the broader movement toward developing 21st-century skills in education, where spatial literacy is recognized as a core competency (Goodchild & Janelle, 2010).

Methodology

Research Design

This study employed a cross-sectional survey design to assess geographic literacy and spatial thinking practices among primary school teachers in Serbia. The quantitative approach was selected to enable statistical comparison across demographic variables and to generate generalizable findings.

Participants

The target population comprised primary school teachers (grades 1–4) currently employed in public schools in Serbia. Participants were recruited through stratified convenience sampling, with the stratification criteria being school location (urban, rural, and urban with rural branch offices) and geographic region (Belgrade, Vojvodina, Šumadija and Western Serbia, Southern and Eastern Serbia, and the Novi Pazar–Sjenica–Tutin–Prijepolje area). Within each stratum, teachers were reached through two channels: online distribution via school director networks and teacher professional associations, and paper-based distribution at professional development meetings in the Sandžak region and Belgrade. The inclusion criteria required respondents to be currently employed as primary school teachers with at least one year of teaching experience. A total of 218 responses were received. Of these, 12 were excluded: 8 due to substantial missing data (more than 20% of items left unanswered) and 4 due to failure to provide informed consent, resulting in a final analytical sample of 206 teachers. All participants provided written informed consent prior to completing the questionnaire.

Table 1. Demographic characteristics of the sample *(N = 206)*

Variable	Category	*N*	%
Gender	Male	17	8.3
	Female	189	91.7
Age	Up to 30	19	9.2
	31–40	52	25.2
	41–50	70	34.0
	Over 50	65	31.6
Education	Higher school / Vocational studies	13	6.3
	Faculty (basic academic studies)	84	40.8
	Master / Magister	106	51.5
	Doctor of Science	3	1.5
Teaching experience	Up to 5 years	21	10.2
	6–15 years	44	21.4
	16–25 years	59	28.6
	Over 25 years	82	39.8
School location	Urban	98	47.6
	Rural	55	26.7
	Urban with rural branch offices	53	25.7
Region	Belgrade	39	18.9
	Vojvodina	21	10.2
	Šumadija and Western Serbia	50	24.3
	Southern and Eastern Serbia	34	16.5
	Novi Pazar, Sjenica, Tutin, Prijepolje	62	30.1
Geography courses during studies	Yes	118	57.3
	No	60	29.1
	Do not remember	28	13.6

The sample is predominantly female (91.7%), which reflects the general gender composition of primary school teaching in Serbia. The largest proportion of respondents (39.8%) had over 25 years of teaching experience, while 10.2% were early-career teachers with up to 5 years of experience. The majority held a Master's degree (51.5%) or a basic academic degree (40.8%). Respondents were distributed across five geographic regions (Figure 1), with the largest group from the Novi Pazar, Sjenica, Tutin, and Prijepolje region (30.1%).

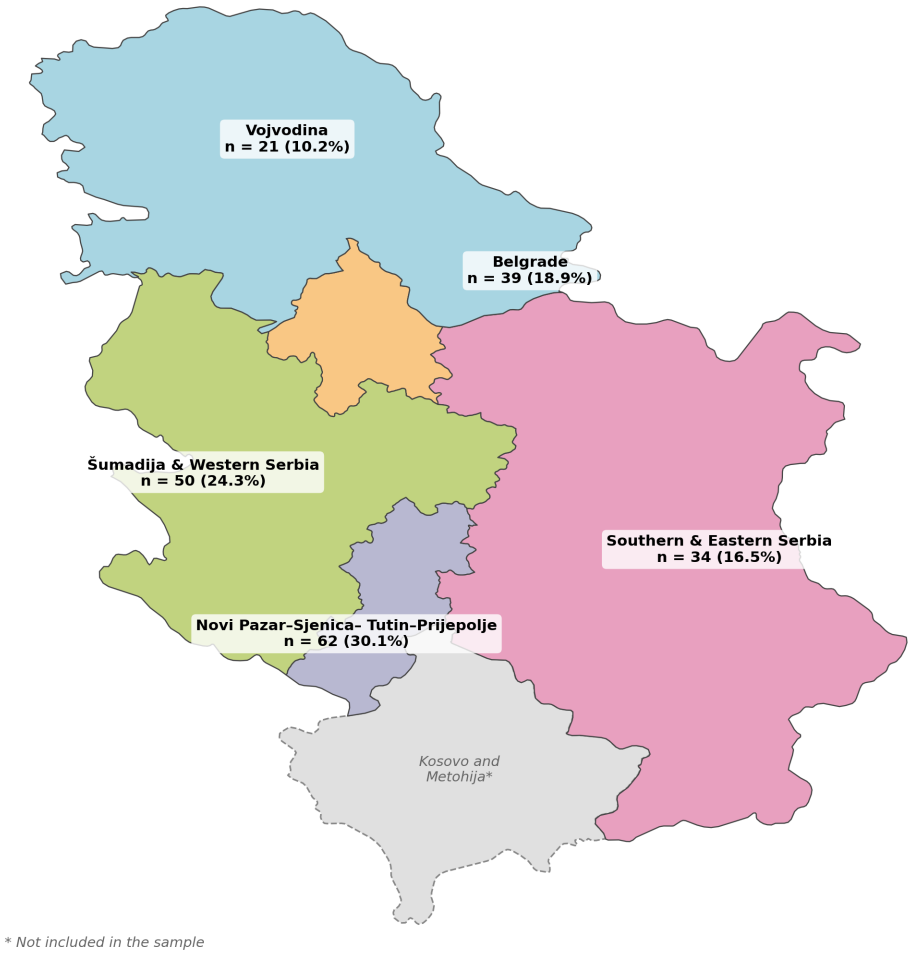

Figure 1. Geographic distribution of the sample across five regions of Serbia (N = 206)

Source: Authors' own elaboration based on Natural Earth data and survey results

Instrument

The research instrument consisted of three sections developed specifically for this study, based on the literature review and adapted to the Serbian educational context:

Section A: Self-Assessment of Geographic Competencies (8 items). This section measured teachers' perceived geographic knowledge and confidence in teaching Nature and Society content. Responses were recorded on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The items (listed in full in Table 2) addressed the following dimensions: perceived sufficiency of geographic knowledge for quality teaching, ability to use geographic maps effectively, confidence in explaining core concepts such as relief, climate, and hydrography, proficiency in spatial orientation and map reading, overall confidence in teaching geographic content, perceived adequacy of undergraduate geographic preparation, engagement in geography-related professional development, and perceived difficulty of geographic content relative to other curriculum areas. Items were developed drawing on the geographic literacy framework proposed by Heffron and Downs (2012) and adapted to reflect the competencies required by the Serbian Nature and Society curriculum (Ministarstvo prosvete, 2019). The scale demonstrated acceptable internal consistency (Cronbach's α = .645).

Section B: Spatial Thinking Practices (10 items). This section assessed how frequently teachers incorporate spatial thinking activities into their Nature and Society teaching. Responses were recorded on a 5-point Likert scale (1 = never to 5 = always). The items (listed in full in Table 3) captured a range of classroom practices: use of geographic maps and atlases, integration of digital geospatial tools such as Google Maps and Google Earth, organization of field activities related to geographic content, use of physical teaching aids including relief models and globes, student-led mapping exercises, development of spatial orientation skills, use of interactive digital tools, connecting geographic content to the students' local environment, comparative geographic analysis, and incorporation of geographic

observations during outdoor activities. The items were informed by research on spatial thinking in education (National Research Council, 2006; Gersmehl, 2014) and the TPACK framework (Mishra & Koehler, 2006), reflecting both traditional and technology-enhanced teaching approaches. The scale yielded a Cronbach's α of .416. This relatively low value likely reflects the conceptual breadth of the construct measured, as the items intentionally span diverse practices — from traditional map use to digital tool integration and outdoor fieldwork — rather than a single narrow behaviour. Similar challenges with internal consistency have been noted in scales measuring multidimensional teaching practices (Lane & Bourke, 2019).

Section C: Geographic Knowledge Test (8 items). This section comprised eight multiple-choice questions designed to assess factual geographic knowledge directly relevant to the Nature and Society curriculum in grades 3 and 4 (Ministarstvo prosvete, 2019). The questions (with correct response rates reported in Table 4) covered the following topics: dominant relief forms in Serbia, the outlet of the Danube River, climate classification of central Serbia, the function of a compass needle, map scale interpretation, the largest lake in the Balkans, the longest river in Serbia, and altitude classification of terrain. Each question offered four response options, with one correct answer. The items were selected to represent a range of geographic knowledge domains — physical geography, cartographic skills, and hydrography — and to vary in cognitive demand from factual recall to applied interpretation.

Prior to the main data collection, the instrument was piloted with a convenience sample of 15 primary school teachers who did not participate in the main study. The pilot aimed to evaluate item clarity, comprehensibility of instructions, and overall response burden. Based on teacher feedback, minor wording adjustments were made to several items in Section A to reduce ambiguity, and the ordering of response options in the knowledge test was reviewed to minimize potential response pattern effects. No items were added or removed following the pilot phase.

Data Collection

Data were collected during March 2026 through both online (Google Forms) and paper-based questionnaire distribution. Online questionnaires were distributed through school director networks and teacher professional associations. Paper questionnaires were administered at teacher professional development meetings in the Sandžak region and Belgrade.

Ethical Considerations

The study was conducted in accordance with the ethical guidelines of the University of Belgrade. As the research involved anonymous survey data from adult professionals and posed no risk beyond that of everyday experience, formal ethics committee approval was not required under the institutional regulations in effect at the time of data collection. All participants were informed of the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time without consequence. Informed consent was obtained from all respondents prior to their participation, either electronically (by confirming consent on the first page of the online questionnaire) or in writing (by signing the consent form attached to the paper questionnaire). No personally identifiable information was collected, and all data were stored and analysed in anonymized form.

Data Analysis

Statistical analyses were performed using IBM SPSS Statistics 26. Descriptive statistics (means, standard deviations, frequencies) were calculated for all variables. Independent samples t-tests were used to examine differences between urban and rural teachers, as well as between teachers with and without prior geographic education. One-way ANOVA with Bonferroni post-hoc correction was employed to examine differences across teaching experience groups and geographic regions. Pearson correlation coefficients were calculated to examine relationships between self-assessed competencies, spatial thinking practices, and knowledge test scores. The significance level was set at $p < .05$ for all analyses.

Results

Self-Assessment of Geographic Competencies

Table 2 presents descriptive statistics for the self-assessed geographic competencies scale. The overall scale mean was 3.66 ($SD = 0.54$), indicating a moderate level of self-assessed geographic competency among the respondents.

The highest-rated item was the ability to explain geographic concepts ($M = 3.96$), followed by confidence in using geographic maps ($M = 3.92$).

The lowest-rated item was the perception that geographic content is the most challenging part of PiD teaching ($M = 2.63$), suggesting that most teachers do not consider geography the most difficult component of the curriculum. Notably, teachers rated their undergraduate geographic preparation relatively low ($M = 3.54$), indicating a perceived gap in initial teacher education.

Table 2. Descriptive statistics for self-assessed geographic competencies *(N = 206)*

Item	*M*	*SD*
P3.1 I have sufficient geographic knowledge for quality PiD teaching	3.81	1.03
P3.2 I can effectively use geographic maps in PiD teaching	3.92	1.02
P3.3 I easily explain concepts such as relief, climate, and water bodies	3.96	0.97
P3.4 I am proficient in spatial orientation and map reading	3.83	1.04
P3.5 I feel confident teaching geographic content in PiD	3.85	1.02
P3.6 My undergraduate studies provided sufficient geographic knowledge	3.54	1.10
P3.7 I regularly update my geographic knowledge through professional development	3.71	0.92
P3.8 Geographic content is the most challenging part of PiD teaching	2.63	0.97
Overall scale mean	**3.66**	**0.54**

Note: Scale: 1 = strongly disagree, 5 = strongly agree. Cronbach's α = .645.

Table 3. Descriptive statistics for spatial thinking practices ***(N = 206)***

Item	*M*	*SD*
P4.1 I use geographic maps and atlases in PiD teaching	3.93	0.89
P4.2 I use Google Maps/Google Earth in teaching	2.88	0.97
P4.3 I organize field activities for geographic content	2.67	1.00
P4.4 I use relief models, globes, and similar teaching materials	2.93	1.04
P4.5 Students create maps/plans of their environment in my classes	3.12	0.99
P4.6 I develop students' spatial orientation skills	3.17	1.03
P4.7 I use interactive digital tools for geographic teaching	2.88	0.92
P4.8 I connect geographic content to students' local environment	3.79	0.93
P4.9 I use comparative geographic analysis in teaching	3.10	0.97
P4.10 I incorporate geographic observations in outdoor activities	2.85	0.94
Overall scale mean	**3.13**	**0.39**

Note: Scale: 1 = never, 5 = always. Cronbach's α = .416.

Spatial Thinking Practices

Table 3 presents the descriptive statistics for spatial thinking practices. The overall scale mean was 3.13 (*SD* = 0.39), indicating moderate frequency of spatial thinking practices in teaching.

The most frequently employed practice was the use of geographic maps and atlases (*M* = 3.93), followed by connecting geographic content to students' local environment (*M* = 3.79). The least frequently employed practices were organizing field activities (*M* = 2.67) and incorporating geographic observations in outdoor activities (*M* = 2.85). The use of Google Maps/Google Earth (*M* = 2.88) and interactive digital tools (*M* = 2.88) was relatively low. Only 25.0% of respondents reported regular use (often or always) of Google Maps/Google Earth in their teaching.

Geographic Knowledge Test Results

Table 4 presents the correct response rates for the geographic knowledge test. The overall mean score was 5.49 out of 8 (68.6% correct).

The compass question had the highest correct response rate (99.0%), followed by the Danube River outlet question (94.5%). The most challenging item was altitude classification (17.0% correct), followed by map scale interpretation (56.5%) and the longest river in Serbia (57.0%). These results indicate specific geographic knowledge gaps among primary school teachers, particularly in quantitative and classification-based geographic concepts.

Differences by School Location

Table 5 presents the results of independent samples t-tests comparing urban and rural school teachers.

Differences by Teaching Experience

Table 6 presents the results of one-way ANOVA comparing teachers across four teaching experience groups.

No statistically significant differences were found between urban and rural school teachers on any of the three measured variables. While urban teachers showed slightly higher self-assessed competencies and knowledge test scores, and rural teachers showed slightly higher spatial thinking practice scores, none of these differences reached statistical significance.

Table 4. Correct response rates on the geographic knowledge test ***(N = 206)***

Question	Topic	Correct (%)
P5.1	Dominant relief forms in Serbia	71.5
P5.2	Danube River outlet (Black Sea)	94.5
P5.3	Climate type of central Serbia	83.0
P5.4	Compass needle direction	99.0
P5.5	Map scale interpretation	56.5
P5.6	Largest lake in the Balkans	70.5
P5.7	Longest river in Serbia	57.0
P5.8	Altitude classification	17.0
Overall mean correct		**68.6**

Table 5. Differences in geographic competencies by school location (t-test)

Variable	Urban *M* (*SD*)	Rural *M* (*SD*)	*t*	*p*
Geographic competencies	3.71 (0.51)	3.60 (0.57)	1.201	.232
Spatial thinking practices	3.12 (0.42)	3.18 (0.36)	−0.933	.352
Knowledge test score	5.68 (1.16)	5.39 (1.11)	1.519	.131

Note: Urban N = 98, Rural N = 55. No significant differences were found at p < .05.

Table 6. Differences in geographic competencies by teaching experience (ANOVA)

Variable	≤5 yrs *M* (*SD*)	6–15 yrs *M* (*SD*)	16–25 yrs *M* (*SD*)	>25 yrs *M* (*SD*)	*F*	*p*
Geographic competencies	3.68 (0.38)	3.49 (0.66)	3.72 (0.50)	3.69 (0.52)	1.708	.167
Spatial thinking practices	3.25 (0.34)	3.25 (0.44)	3.18 (0.37)	3.01 (0.35)	5.296	.002**
Knowledge test score	5.45 (1.10)	5.49 (1.32)	5.46 (1.27)	5.53 (1.17)	0.043	.988

*Note: N (≤5 yrs) = 21, N (6–15 yrs) = 44, N (16–25 yrs) = 59, N (>25 yrs) = 82. *p < .05, **p < .01, ***p < .001.*

A statistically significant difference was found in spatial thinking practices across teaching experience groups (F = 5.296, p = .002). As illustrated in Figure 2, teachers with over 25 years of experience reported the lowest mean spatial thinking scores. Bonferroni post-hoc tests confirmed that this group differed significantly from all three other groups: compared to teachers with up to 5 years (p = .031), 6–15 years (p = .007), and 16–25 years of experience (p = .044). No significant differences were found for self-assessed geographic competencies or knowledge test scores across experience groups.

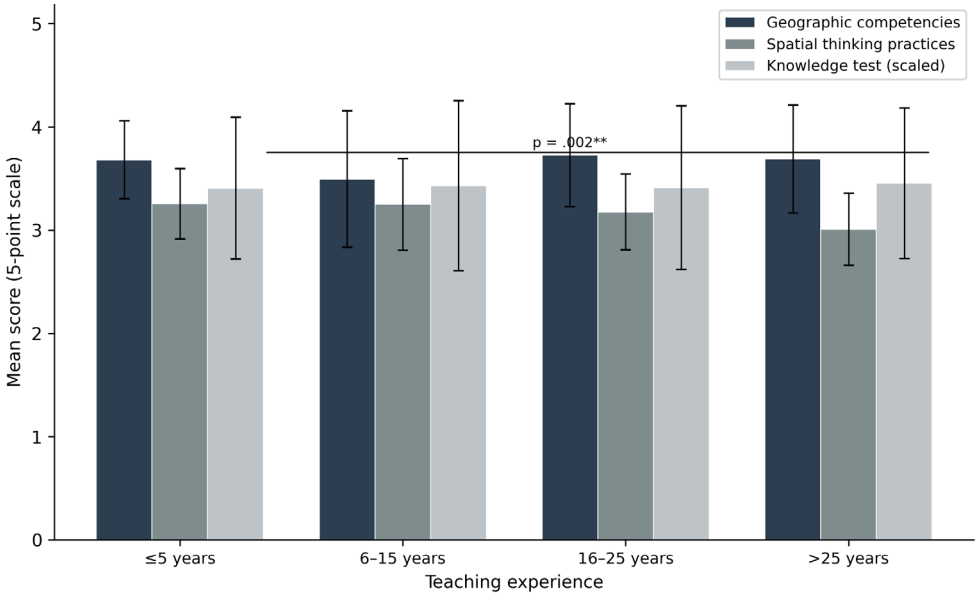

Figure 2. Mean scores on geographic competencies, spatial thinking practices, and knowledge test (scaled to 5-point) by teaching experience group. Error bars represent standard deviations. **p < .01

Source: Authors' research, based on survey data (N = 206)

Differences by Geographic Education Background

Table 7 presents the results of independent samples t-tests comparing teachers who reported having had geography courses during their university studies versus those who did not.

Teachers who had geography courses during their university studies showed significantly higher scores on all three variables: self-assessed geographic competencies (t = 3.093, p = .002), spatial thinking practices (t = 3.468, p < .001), and geographic knowledge test scores (t = 2.027, p = .044).

Differences by Region

One-way ANOVA revealed no statistically significant differences across the five geographic regions for any of the three measured variables: geographic competencies (F = 0.620, p = .649), spatial thinking practices (F = 0.462, p = .764), and knowledge test scores (F = 1.184, p = .319).

Correlation Analysis

Pearson correlation analysis revealed a moderate positive correlation between self-assessed geographic competencies and spatial thinking practices (r = .315, p < .001; Figure 3), indicating that higher self-assessed competency tends to co-occur with more frequent use of spatial thinking practices in teaching. However, as this is a cross-sectional correlation, the direction of this relationship cannot be established — it is equally pos-

Table 7. Differences by geographic education during university studies (t-test)

Variable	Yes *M* (*SD*)	No *M* (*SD*)	*t*	*p*
Geographic competencies	3.77 (0.52)	3.52 (0.52)	3.093	.002**
Spatial thinking practices	3.22 (0.39)	3.01 (0.33)	3.468	<.001***
Knowledge test score	5.63 (1.21)	5.24 (1.11)	2.027	.044*

*Note: Yes N = 118, No N = 60. *p < .05, **p < .01, ***p < .001. Teachers who selected "Do not remember" (N = 28) were excluded from this analysis.*

sible that teachers who engage more in spatial thinking activities develop greater confidence, or that a third variable, such as interest in geography, influences both. A weak but significant positive correlation was observed between spatial thinking practices and knowledge test scores (r = .164, p = .020). The correlation between self-assessed competencies and knowledge test scores was not statistically significant (r = .127, p = .073), suggesting a possible disconnect between teachers' perceived and demonstrated geographic knowledge, though the limited scope of the knowledge test (8 items) warrants caution in interpreting this finding.

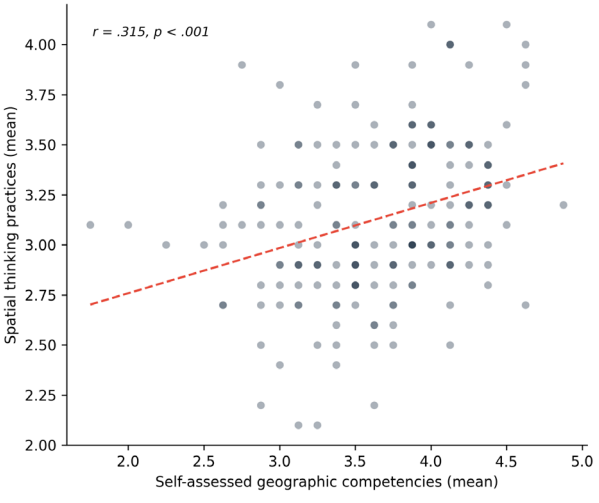

Figure 3. Scatterplot of the relationship between self-assessed geographic competencies and spatial thinking practices (N = 206). The dashed line represents the linear trend.

Source: Authors' research, based on survey data (N = 206)

Discussion

The findings of this study provide empirical insight into the geographic literacy and spatial thinking capabilities of primary school teachers in Serbia. The results reveal several important patterns that carry implications for teacher education and curriculum development.

Geographic Competency Levels

The moderate levels of self-assessed geographic competency (M = 3.66) are consistent with findings from comparable contexts. Preston (2015) reported similar patterns among primary school teachers in Australia, and Catling and Morley (2013) found that primary teachers in England often have limited and uneven geographic subject knowledge, noting that generalist educators frequently feel underprepared for geographic content delivery. In Serbia, this is particularly relevant because primary school teachers receive only limited geography-specific coursework during their undergraduate training at faculties of education — a concern reflected in the relatively low rating for undergraduate preparation (M = 3.54), which was the lowest-rated item on the competency scale apart from perceived difficulty.

What is perhaps more telling than the overall competency scores is the non-significant correlation between self-assessed competencies and actual knowledge test performance (r = .127, p = .073). This gap between perceived and demonstrated knowledge echoes the broader literature on calibration accuracy in professional self-assessment (Kruger & Dunning, 1999) and raises a practical concern: if teachers overestimate their geographic competency, they may be less likely to seek out additional training in areas where they would benefit from it. This suggests that professional development initiatives in this domain should incorporate objective diagnostic components rather than relying solely on teachers' self-identified needs.

Spatial Thinking Practices and the Experience Paradox

A particularly noteworthy finding is the significant decline in spatial thinking practices among teachers with over 25 years of experience (F = 5.296, p = .002). This "experience paradox" — where more experienced teachers employ fewer innovative pedagogical approaches — may be explained by several factors. First, veteran teachers may have been trained in an era when spatial thinking was not explicitly emphasized in teacher education curricula. Second, the rapid evolution of geospatial technologies may create a digital divide, with older teachers less comfortable incorporating these tools into their practice. Third, routinization of teaching practices over decades may reduce willingness to adopt new approaches (Day & Gu, 2010).

This finding carries implications for professional development planning. Rather than assuming that experienced teachers need less support, it may be worthwhile to consider targeted interventions aimed at helping veteran educators update their spatial thinking pedagogies and become familiar with contemporary geospatial tools. That said, these results should be interpreted in light of the modest internal consistency of the spatial thinking practices scale (α = .416). While the significant group differences are statistically robust, the heterogeneity of the scale means that the observed pattern may not apply equally to all types of spatial thinking practices captured by the instrument.

Low Adoption of Geospatial Technologies

The finding that only 25.0% of teachers regularly use Google Maps/Google Earth is concerning but consistent with international trends. Despite the demonstrated educational potential of tools such as Google Earth (Patterson, 2007), Kerski (2015) noted that their integration into primary education remains limited globally. In Serbia, potential barriers include limited ICT in-

frastructure, insufficient training during initial teacher education, and lack of curriculum-aligned resources for these technologies. The low use of field activities (M = 2.67) and outdoor observations (M = 2.85) further suggests a heavy reliance on classroom-based, textbook-oriented approaches.

Geographic Knowledge Gaps

The geographic knowledge test results (overall mean: 68.6% correct) point to uneven performance across different types of geographic knowledge. While teachers performed well on items involving commonly encountered facts — such as the outlet of the Danube River (94.5%) and compass function (99.0%) — performance was notably lower on items requiring more specialized or quantitative knowledge, particularly altitude classification (17.0%) and map scale interpretation (56.5%). The low score on altitude classification should be interpreted with caution, as it represents a single item and may partly reflect ambiguity in the question wording or unfamiliarity with the specific classification system used. Nonetheless, taken together with the relatively low performance on map scale interpretation, these results suggest that quantitative and classification-based geographic concepts may represent an area where teachers would benefit from additional support.

These patterns are broadly consistent with the findings of Lešćešen et al. (2024), who identified gaps in climate change knowledge among primary school students in Serbia. While our test comprised only eight items and cannot provide a comprehensive assessment of teachers' geographic knowledge, the results offer an initial indication that certain curriculum-relevant topics may deserve greater attention in teacher preparation and professional development.

The Role of Geographic Education During University Studies

The significant differences found between teachers who had geography courses during university studies and those who did not — across all three measured variables — provide strong empirical support for the value of geographic content in teacher preparation programs. Teachers with geographic education background demonstrated higher self-assessed competencies (p = .002), more frequent spatial thinking practices (p < .001), and better geographic knowledge (p = .044). This finding underscores the importance of maintaining and strengthening geographic coursework within faculty of education curricula, even as programs face pressure to accommodate new content areas.

Absence of Urban-Rural and Regional Differences

Contrary to expectations, no statistically significant differences were found between urban and rural teachers or across the five sampled regions on any of the three measured variables. While this absence of regional variation might suggest that the challenges identified in this study are not confined to a particular area, this interpretation should be treated with caution. The sample was not proportionally representative of the national teacher population, and the overrepresentation of respondents from the Novi Pazar–Sjenica–Tutin–Prijepolje area (30.1%) limits the extent to which regional comparisons can be generalized. Future research with more balanced regional sampling would be needed to determine whether geographic literacy challenges are indeed uniform across Serbia or whether meaningful regional differences exist that the present sample was unable to detect.

Implications for Teacher Education

The findings carry several practical implications. First, faculties of education should strengthen geographic content in teacher preparation, emphasizing quantitative concepts (scale, altitude) where gaps were most pronounced. Second, professional development should incorporate geospatial technology training. Third, special attention should be given to veteran teachers, who demonstrated significantly lower engagement with spatial thinking practices. Fourth, curriculum-aligned resources connecting geospatial technologies to Nature and Society learning outcomes could support broader adoption.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the use of convenience sampling limits the generalizability of the results to the broader population of Serbian primary school teachers. The overrepresentation of the Sandžak region (30.1%) reflects the researcher's professional networks in this area and may introduce regional bias, despite the absence of statistically significant regional differences in the data.

Second, the self-report nature of the geographic competency and spatial thinking practice scales introduces the possibility of social desirability bias, whereby teachers may overstate their competencies or the frequency of their spatial thinking practices. The non-significant correlation between self-assessed competencies and knowledge test scores (r = .127) lends some support to this concern.

Third, the modest internal consistency of the spatial thinking practices scale (α = .416) represents a methodological limitation. While we have argued that this reflects the intentional breadth of the construct, it also means that findings based on this scale — including the significant differences across experience groups — should be interpreted with appropriate caution. Future research should consider developing subscales for distinct categories of spatial thinking practices (e.g., traditional map-based activities vs. digital tool use) to improve reliability while preserving construct coverage.

Fourth, the geographic knowledge test comprised only eight items and assessed a limited range of curriculum-relevant topics. It should therefore be regarded as a screening measure rather than a comprehensive assessment of teachers' geographic knowledge. The very low performance on the altitude classification item (17.0%) may reflect item-specific factors as much as genuine knowledge gaps.

Finally, the cross-sectional design precludes causal inferences about the relationships between variables. Future studies should employ larger and more representative samples, consider longitudinal or quasi-experimental designs, incorporate classroom observation alongside self-report measures, and examine the relationship between teacher geographic literacy and student learning outcomes.

Conclusion

This study examined geographic literacy and spatial-thinking practices among 206 primary school teachers across five regions of Serbia. The results indicate moderate levels of self-assessed geographic competency, limited use of geospatial technologies, and uneven performance on a curriculum-aligned knowledge test. Among the key findings, teachers with over 25 years of experience reported significantly lower spatial thinking practices than their less experienced colleagues, and teachers who had completed geography courses during their university studies scored higher across all three measured dimensions. These patterns, while subject to the limitations of the instruments and sampling approach discussed above, point to areas that may warrant attention in teacher education and professional development — particularly the integration of quantitative geographic concepts and geospatial tools into both pre-service and in-service training. Future research with larger and more representative samples, refined measurement instruments, and classroom observation methods would help to establish a more robust evidence base for policy recommendations in this domain.

References

Baker, T. R., Battersby, S., Bednarz, S. W., Bodzin, A. M., Kolvoord, B., Moore, S., & Uttal, D. (2015). A research agenda for geospatial technologies and learning. *Journal of Geography, 114*(3), 118–130. https://doi.org/10.1080/00221341.2014.950684

Catling, S. (2004). An understanding of geography: The perspectives of English primary trainee teachers. *GeoJournal, 60*(2), 149–158. https://doi.org/10.1023/B:GEJO.0000033577.09481.87

Catling, S., & Morley, E. (2013). Enquiring into primary teachers' geographical knowledge. *Education 3–13, 41*(4), 434–442. https://doi.org/10.1080/03004279.2013.819625

Day, C., & Gu, Q. (2010). *The new lives of teachers*. Routledge.

Edelson, D. C. (2012). *Geo-literacy: Preparation for far-reaching decisions*. National GeographicEducation.https://education.nationalgeographic.org/resource/geo-literacy-preparation-far-reaching-decisions/

Gersmehl, P. (2014). *Teaching geography* (3rd ed.). Guilford Press.

Goodchild, M. F., & Janelle, D. G. (2010). Toward critical spatial thinking in the social sciences and humanities. *GeoJournal, 75*(1), 3–13. https://doi.org/10.1007/s10708-010-9340-z

Heffron, S., & Downs, R. M. (Eds.). (2012). *Geography for life: National geography standards* (2nd ed.). National Council for Geographic Education.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42*(2), 371–406. https://doi.org/10.3102/00028312042002371

Ivkov-Džigurski, A., Ivanović Bibić, L., Dragin, A., Miljanović, D., & Đukičin Vučković, S. (2019). The evaluation of the geography textbook quality from the students' perspective. *Geographica Pannonica, 23*(2), 121–133. https://doi.org/10.5937/gp23-22084

Jo, I., & Bednarz, S. W. (2009). Evaluating geography textbook questions from a spatial perspective: Using concepts of space, tools of representation, and cognitive processes to evaluate spatiality. *Journal of Geography, 108*(1), 4–13. https://doi.org/10.1080/00221340902758401

Kerski, J. J. (2015). Geo-awareness, geo-enablement, geotechnologies, citizen science, and storytelling: Geography on the world stage. *Geography Compass, 9*(1), 14–26. https://doi.org/10.1111/gec3.12193

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology, 77*(6), 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121

Lane, R., & Bourke, T. (2019). Assessment in geography education: A systematic review. *International Research in Geographical and Environmental Education, 28*(1), 22–36. https://doi.org/10.1080/10382046.2017.1385340

Lešćešen, I., Basarin, B., & Vujičić, M. (2024). What do they know? Is climate change education

necessary in primary schools in Serbia? *Geographica Pannonica, 28*(2), 85–103. https://doi.org/10.5937/gp28-48045

Lukić, T., Božić, S., Sakulski, D., Babić-Kekez, S., Ivanović Bibić, L., Besermenji, S., & Dolinaj, D. (2016). Achieving competencies with grammar school students through utilisation of selected didactical principles in traditional and active teaching: Geography class case study: "Hydrography of Serbia." *Geographica Pannonica, 20*(4), 254–264. https://doi.org/10.18421/GP20.04-07

Milson, A. J., Demirci, A., & Kerski, J. J. (Eds.). (2012). *International perspectives on teaching and learning with GIS in secondary schools*. Springer. https://doi.org/10.1007/978-94-007-2120-3

Ministarstvo prosvete, nauke i tehnološkog razvoja [Ministry of Education, Science and Technological Development]. (2019). *Pravilnik o planu nastave i učenja za prvi ciklus osnovnog obrazovanja i vaspitanja i programu nastave i učenja za treći razred osnovnog obrazovanja i vaspitanja* [*Regulation on the curriculum for the first cycle of primary education and the teaching programme for the third grade of primary education*]. *Službeni glasnik Republike Srbije*.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

National Research Council. (2006). *Learning to think spatially: GIS as a support system in the K–12 curriculum*. National Academies Press. https://doi.org/10.17226/11019

Newcombe, N. S. (2010). Picture this: Increasing math and science learning by improving spatial thinking. *American Educator, 34*(2), 29–43.

Patterson, T. C. (2007). Google Earth as a (not just) geography education tool. *Journal of Geography, 106*(4), 145–152. https://doi.org/10.1080/00221340701678032

Preston, L. (2015). The place of place-based education in the Australian primary geography curriculum. *Geographical Education, 28*, 41–49.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4–14. https://doi.org/10.3102/0013189X015002004

Stojšić, I., Ivkov-Džigurski, A., & Maričić, O. (2019). The readiness of geography teachers to use mobile devices in the context of immersive technologies integration into the teaching process. *Geographica Pannonica, 23*(2), 121–133. https://doi.org/10.5937/gp23-20762

Šaćirović, D., & Bratić, M. (2021). Motivational factors and satisfaction of foreign tourists visiting Belgrade as tourist destination according to their social and demographic characteristics. *Fresenius Environmental Bulletin, 30*(4A), 4085–4093.

Uttal, D. H., Meadow, N. G., Tipton, E., Hand, L. L., Alden, A. R., Warren, C., & Newcombe, N. S. (2013). The malleability of spatial skills: A meta-analysis of training studies. *Psychological Bulletin, 139*(2), 352–402. https://doi.org/10.1037/a0028446