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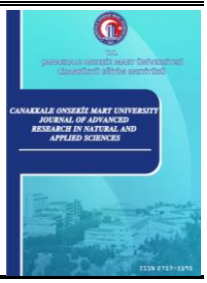

e-ISSN: 2757-5195 2024, Vol. 10, Issue 3, Pages: 702-725 doi.org/10.28979/jarnas.1482657

Unlocking Cognitive Horizons by Exploring the Influence of Maps on Primary School Pupils: An Examination Conducted in North Macedonia

Edmond Jonuzi[1], Hüseyin Zahit Selvi[2]

[1, 2]Department of Geomatics Engineering, Faculty of Engineering, Necmettin Erbakan University, Konya, Türkiye

Article Info

Received: 12 May 2024

Accepted: 12 Aug 2024

Published: 30 Sep 2024

Research Article

Abstract − This study thoroughly investigates the effects of utilizing maps as educational tools for children, aiming to enhance pupils' cognitive abilities and improve the overall educational system within primary schools. By exploring the potential benefits of incorporating cartographic materials into the curriculum, this research sheds light on their positive impact on children's intellectual growth and the educational framework at the elementary level, such as primary schools. The primary aim of this investigation is to deliver an interactive and compelling educational resource tailored for pupils aged between 7 and 10 years old. Pre-test and post-test were conducted with 377 primary school pupils in Tetovo, North Macedonia. Employing a comprehensive mixed-methods approach and through a meticulous analysis of the potential benefits of integrating maps into the pedagogical framework, this study aims to provide valuable insights into the positive effects they can have on children's skill acquisition and the overall efficacy of the educational system. Ultimately, the findings of this study are expected to inform educational stakeholders by furnishing empirical evidence on the advantages of incorporating maps into the learning process for young learners, thus contributing to more effective educational practices. The study's findings demonstrate a predominantly favorable reception, emphasizing the efficacy and educational utility of the maps and atlases among young pupils. The analysis shows that employing the maps and atlas led to an average enhancement in pupils' learning abilities, with an approximate mean increase of 31.45%.

Keywords – *Map utilization, children's skill development, cognitive development, educational system improvement, map use*

1. Introduction

Cartography is a potent and influential medium for effective communication [1]. Maps serve as the primary embodiments of cartographic representation. Maps are ubiquitously available and find utility across various fields and disciplines [2]. Maps enjoy substantial popularity widespread appeal, and serve as visual depictions [3,4], and they can be utilized by a diverse range of individuals [5]. Maps are additionally employed within the educational system to support various pedagogical endeavors. Cartographers possess the specialized knowledge and skills required to facilitate the education of educators and other influential stakeholders, including parents, who play a vital role in fostering children's appreciation and comprehension of maps [6]. The contemporary young learners of the present have the potential of map users, map compilers and map designers of the future. Designing assistive technologies specifically catered to the requirements of children, encompassing maps as well, presents considerable challenges [7]. It is essential to provide young learners with the necessary skills. Educators or teachers play a crucial role in guiding pupils to articulate their thoughts explicitly, assisting pupils in elucidating and refining their reasoning within the framework of the norms and

[1]edmondjonuzi1@gmail.com (Corresponding Author); [2]hzselvi@erbakan.edu.tr

criteria [8]. There is a consensus among researchers that children at a young age, specifically in the early stages of primary school, possess the cognitive capacity to comprehend maps [9]. Comprehending maps presents a viable avenue for exploring children's grasp of spatial relationships [10]. It has been hypothesized that children and adults perceive maps and interpret spatial information differently [11-13]. The identified and purported disparities in comprehension between adults and children have engendered a proliferation of maps meticulously tailored for children by publishers and cartographers, deviating from those originally intended for adult audiences [14]. Curriculum developers may need to address the inclusion of explicit geographical and cartographic vocabulary within the educational framework [15]. Within the educational realm, maps are widely regarded as indispensable communication tools [9]. The exploration of color within maps has been the subject of comprehensive inquiry in cartographic research, representing one of the most extensively examined aspects of map design [16-24]. The expressive capabilities of young children are not fully developed; thus, it is more advantageous for them to communicate their genuine emotions and thoughts through non-verbal means such as pictures, charts, concept maps, and semantic networks [25]. Geographical education has always been concerned with systematically teaching and learning map skills [26]. Children's proficiency in map-reading skills offers significant insights into a particular form of representational competence [27]. Maps convey information through the utilization of signs and symbols, augmented by additional details presented through the inclusion of words, letters, and numbers, facilitating the process of decoding and interpretation [26]. Cartographers have recognized that maps do not provide a direct and unambiguous portrayal of the world; rather, maps function as representations that offer diverse interpretations of reality, allowing human cognition to perceive distinct versions of truth [28]. Piaget's theory of cognitive development elucidates the process through which a child constructs a cognitive framework, or mental model, to comprehend the world [29]. Jean Piaget dedicated approximately five decades of his career to investigating children's cognitive development [30]. According to Piaget's theory, pupils and students require a curriculum that fosters their cognitive development by facilitating the acquisition of concepts and logical reasoning skills [31]. An important implication of Piaget's theory is the need to adapt instruction to the learner's developmental level, ensuring that the content aligns with their stage of development. In this context, the educator or teacher plays a crucial role in facilitating learning by offering diverse experiences that allow learners to explore, experience, and develop new understandings [32]. Cognitive development is explicated through a succession of hierarchical skill structures known as levels, accompanied by transformation rules that establish the interrelationships between these levels [33]. Cartography and cartographers shoulder substantial responsibilities in creating maps that are customarily crafted to cater to children's unique requirements, align with educational curricula, and correspond to the cognitive development levels of children [3]. In recent years, enhanced maps that adhere to more comprehensive standards and are being introduced into the market have notably emerged. This trend has also affected atlases. An increasing number of atlas projects are being undertaken for educational purposes, encompassing diverse subject matter and content [34-37]. The utilization of maps as pedagogical tools in primary education has gained significant attention due to its potential influence on children's cognitive development and the overall effectiveness of the educational system. By incorporating cartographic materials into the curriculum, educators seek to engage pupils in spatial thinking, enhance their problem-solving skills, and foster a deeper understanding of geographical concepts. However, despite the widespread use of maps in primary schools, limited empirical research has systematically examined their impact on pupils' abilities and the educational framework. Several comparative studies have been conducted across various nations, focusing on promoting cartographic literacy among elementary school pupils by utilizing maps and atlases. In different studies, it is also seen that map use starts at different ages in different countries: 2nd grade (7 years) in Hungary [38], 1st grade (6 years) in Bulgaria [39], 2nd grade (7 years) in Azerbaijan [40]. Integrating maps and atlases into geography education is also widespread in Bulgaria; a child's acquaintance with cartography begins with the first map they see; children often see maps in books and thus try to read them [5]. Kramáreková et al. (2016) [41] state that pupils in the Czech Republic acquire their first cartographic knowledge and skills already in primary school education, mainly through social science textbooks. The course 'Nature and Society' is part of the national education program in education and is taught in the second, third, and fourth grades of primary schools. According to Buğdaycı and Bildirici [42], it is possible to find three groups of atlases in the education

system in Turkey: the first atlas for grades 4,5 (ages 10, 11), the middle atlas for grades 6,7,8 (ages 12-14) and the basic atlas for grades 9,10,11,12 (ages 15-19). According to the study project of Reyes Nunez et al. [38], in Hungary, pupils are first introduced to elementary map concepts between the 3rd and 5th grades of primary school. As they grow older, in grade 6, students use maps more frequently in related subjects such as geography and history. By grade 7, according to the authors, students should have practical experience with thematic maps and general maps. Safaraliyeva et al. [40] produced educational maps in the first Geography textbooks, which constitute the beginning of teaching map concepts in Azerbaijani schools. Map-related concepts are included in the curriculum under the 'Life Science' course from grade 2 to grade 5, followed by the geography course from grade 6 to grade 11. This study aims to address this gap in the literature by investigating the effects of utilizing maps for children, highlighting the potential benefits they offer to both pupils and the primary school education system. The study seeks to provide empirical evidence on the advantages of incorporating maps into the learning process for young learners, thus contributing to more effective educational practices and informing educational stakeholders. The findings of this study are expected to contribute to educational practices by providing valuable insights into the positive effects of incorporating maps in primary education. These insights will inform educational stakeholders, enabling them to make informed decisions and enhance the overall efficacy of the educational system. Ultimately, the research strives to create a foundation for evidence-based educational practices that maximize pupils' cognitive abilities and promote a comprehensive understanding of geographical concepts. The main assumption posits that this integration enhances children's learning. Subsidiary assumptions include the assertion that maps as pedagogical tools increase engagement in spatial thinking and problem-solving skills, improve knowledge acquisition of geographical concepts and specifics about North Macedonia, and that effectiveness varies across grades due to developmental cognitive differences. The study seeks to validate these assumptions through rigorous analysis of pre- and post-atlas test results among primary school pupils in North Macedonia, aiming to provide empirical evidence supporting the educational benefits of using maps in classrooms. This study is situated within the framework of a project focused on the compilation and design of an atlas intended for primary school pupils in the Republic of North Macedonia. The atlas project constitutes an integral component of the diploma study research pursued by the corresponding author of this article.

2. Materials and Methods

A comprehensive mixed-methods research design was employed to investigate the impact of map usage on children's development and the educational system. This study aims to thoroughly understand the effects of incorporating maps and atlases as educational tools in primary education. Developing the pre-atlas and post-atlas tests was an integral part of the overall process involved in creating and designing maps for the dedicated atlas aimed at primary school pupils in the Republic of North Macedonia. The maps and the accompanying content of the atlas, such as symbols and population-related tables, were meticulously tailored to align with the cognitive abilities, age range, and spatial reasoning skills of primary school pupils. Extensive testing of the pre-atlas test and post-atlas test, which encompassed both general knowledge about the Republic of North Macedonia and the maps specifically compiled and designed for inclusion in the atlas, were conducted with primary school pupils. The pre-test aimed to assess pupils' overall knowledge regarding the Republic of North Macedonia, encompassing its geography, culture, history, tourism, and economy.

Conversely, the post-test aimed to appraise the influence of newly developed maps within the "Atlas of North Macedonia for primary school pupils" initiative, specifically their role in enhancing the efficiency and effectiveness of learning, thereby contributing to the broader improvement and advancement of education quality. Prior to conducting the pre- and post-tests, relevant authorities, including the Ministry of Education and Science of the Republic of North Macedonia and the Municipality of Tetovo, in collaboration with the regional office of the Ministry of Education and Science at the municipal level, were duly informed. Pupil assessments were conducted anonymously; pupils indicated only their class without providing personal identifiers such as first and last names. A similar anonymized approach was employed for teacher questionnaires, where respondents indicated only their teaching assignment without disclosing personal

details. The primary objective of this testing phase was to ensure that the maps and accompanying information were clear, comprehensible, and suitable for the intended users. In assessing the significance of observed disparities among distinct groups within our sample, t-tests were employed and computed via Microsoft Excel. The utilization of t-tests is pivotal in gauging the impact of an experimental intervention. This statistical methodology, supported by Excel, enhances the robustness and credibility of our results, thereby establishing a firm foundation for the conclusions drawn in this scholarly investigation. The findings of this research will contribute to the field of primary education by providing empirical evidence on the advantages and challenges of utilizing maps as educational tools. Educators, curriculum developers, and policymakers can leverage these findings to inform their decision-making processes and improve teaching practices. Ultimately, this study seeks to enhance the learning experiences of young learners and promote the effective integration of maps into the primary education system.

2.1. Participants

A cohort of 377 primary school pupils, aged 7 to 10 years, actively participated in pre- and post-atlas assessment phases, which comprised evaluations featuring specially crafted maps for the Atlas and general knowledge pertaining to North Macedonia. The demographic breakdown encompassed 84 pupils from third, 140 from fourth, and 153 from fifth. To mitigate potential confounding variables such as socio-economic status and environmental factors, four comparable schools were meticulously chosen within the municipality of Tetovo, situated in the northwestern precinct of North Macedonia. Three of these selected educational institutions were situated within urban settings, while one was in a rural village on the city's outskirts. This deliberate selection process aimed to ensure a comprehensive and varied representation of contexts for the assessment phase.

2.2. Designed and Compiled Tests

The pre-atlas test consists of 15 general questions specifically designed to assess the knowledge of primary school pupils in the lower grades, ranging from 7 to 10 years of age. These questions primarily revolve around various aspects concerning the Republic of North Macedonia. The selection and design of these questions were tailored to align with the target age group's cognitive abilities and educational level. Also, the post-atlas test consists of 15 general questions specifically designed to assess the knowledge of primary school pupils in the lower grades, ranging from 7 to 10 years of age. These questions primarily revolve around various aspects concerning the Republic of North Macedonia. The selection and design of these questions were tailored to align with the target age group's cognitive abilities and educational level. The questions formulated for both the pre- and post-atlas tests are directly linked to the maps compiled and designed specifically for the Atlas, including general information. These questions are designed to assess the pupils' understanding and interpretation of the information presented on the maps within the Atlas. The content of the questions is aligned with the geographic features, symbols, and thematic elements depicted on the maps, ensuring that the pupils' knowledge and comprehension of the map content are effectively evaluated. By analyzing the outcomes of the pre-atlas test and the post-atlas test, a comparison can be drawn to assess the impact of the atlas on the enhancement of general knowledge, which allows us to present the results indicating the improvement achieved.

3. Results and Discussion

3.1. Results

Analyzing both the pre-atlas test data and post-atlas test data will provide valuable insights into the correlation between map usage and pupils' skill development and cognitive development as well as the educational system's positive impact and overall efficacy. Pre-atlas and post-atlas tests will offer numerical findings on

pupils' spatial reasoning abilities, problem-solving skills, and academic performance, providing a statistical basis for understanding the impact of map utilization. These tests will explore the benefits of using cartographic materials, such as increased pupil engagement, motivation, and the facilitation of interdisciplinary learning. Additionally, the tests will shed light on the challenges faced by educators, including resource limitations and the need for adequate training. By combining these test data, this study aims to provide a comprehensive perspective on the advantages, challenges, and potential improvements related to integrating maps into primary education. The tables below represent the pre-atlas test and post-atlas test questions administered to the pupils:

Table 1. An overview of the pre-atlas test questions administered to primary school pupils

Questions No.	Questions
Question 1	Which of these states does the Republic of North Macedonia not share a border with?
Question 2	What is the number of regions in the Republic of North Macedonia?
Question 3	In which region of North Macedonia does the city of Bitola belong?
Question 4	What is the number of cities in the Republic of North Macedonia?
Question 5	What is the capital city of the Republic of North Macedonia?
Question 6	What is the number of municipalities in the Republic of North Macedonia?
Question 7	How many natural lakes does North Macedonia have?
Question 8	What is the largest natural lake in North Macedonia?
Question 9	What is the largest river in North Macedonia?
Question 10	What is the highest mountain in North Macedonia?
Question 11	What is the symbol of the city of Skopje?
Question 12	Which state does North Macedonia share a border with the east?
Question 13	What is the largest plain in the Republic of North Macedonia?
Question 14	The relief of the Republic of North Macedonia is predominantly characterized by?
Question 15	What is the resident population count in the Republic of North Macedonia?

Table 2. An overview of the post-atlas test questions administered to primary school pupils

Questions No.	Questions
Question 1	In which region does the skiing center "Mavrova" belong?
Question 2	How many countries border the Republic of North Macedonia?
Question 3	In which region of North Macedonia does the city of Debar belong?
Question 4	The Museum of the Alphabet of the Albanian Language is located in the city of?
Question 5	In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?
Question 6	What is the largest ethnic group in the Republic of North Macedonia?
Question 7	Which is the most populated region in the Republic of North Macedonia?
Question 8	Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?
Question 9	Trofta fish is characteristic of the city of?
Question 10	In which city of North Macedonia is the Monument of Ilinden - Makedonium?
Question 11	Sharr's dog is characteristic of the region of?
Question 12	The old/ancient city of Stobi is located in the region of?
Question 13	Which of these elements is considered a historical element in Tetova?
Question 14	In which city of the Republic of North Macedonia is rice grown?
Question 15	Matka Canyon and Mustafa Pasha Mosque are part of the city of?

3.1.1. Pre-Atlas Test

A thorough preliminary assessment concerning general knowledge related to the Atlas was administered, involving 84 third-grade pupils from a primary school who participated in an atlas presentation, forming the experimental group. It is essential to underscore that the percentages in the following table represent the ratio of accurate affirmative responses the pupils gave. Following the completion of the preliminary assessment for primary school pupils, the outcomes derived from this evaluation are delineated in the subsequent table:

Table 3. An overview of the pre-atlas test questions administered to third-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Question 1	34.52 %
Question 2	40.48 %
Question 3	10.71 %
Question 4	20.24 %
Question 5	51.19 %
Question 6	16.67 %
Question 7	26.19 %
Question 8	70.24 %
Question 9	36.91 %
Question 10	13.10 %
Question 11	50.00 %
Question 12	20.24 %
Question 13	11.91 %
Question 14	27.38 %
Question 15	21.43 %

As per the information in the provided tabular data, it can be inferred that question number 8 manifests the highest mean percentage of accurate responses, reaching 70.24%. In contrast, question number 3 illustrates the lowest mean percentage of accurate responses, registering at 10.71%.

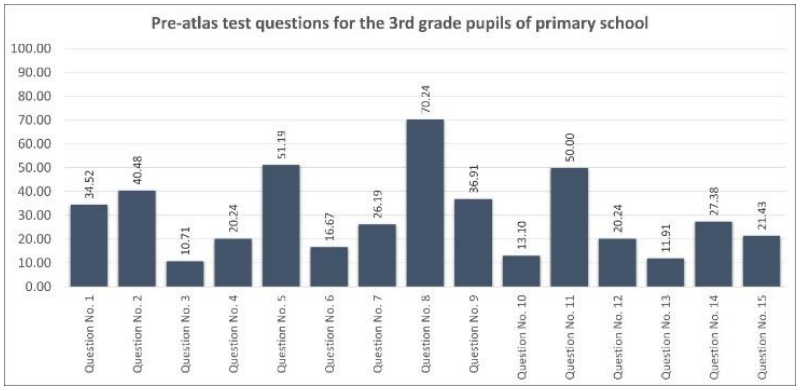

Figure 1. Pre-atlas test questions for the 3rd-grade pupils who did participate in the Atlas presentation and the success percentages are represented with a chart

The ensuing pre-atlas test was carried out on third-grade pupils, involving 15 carefully formulated inquiries. These questions were categorized into three domains: A) Concepts related to Maps and Atlases, B) Comprehension of Directions, geographical regions, and neighboring areas, and C) Understanding of Tourism and Economy in North Macedonia. The subsequent table offers a detailed summary of the outcomes corresponding to these specific categories for third-grade pupils:

Table 4. An overview of the pre-atlas test questions of categories administered to third-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Category A	21.43 %
Category B	29.21 %
Category C	50.00 %

Derived from the information delineated in the presented tabular data, it is discernible that inquiries falling under Category C showcase the most elevated mean accuracy, attaining a value of 50.00%. Subsequently,

queries classified under Category B also showcase a notable accuracy rate, totaling 29.21%. In contrast, questions categorized under Category A exhibit the lowest mean accuracy, sustaining a rate of 21.43%.

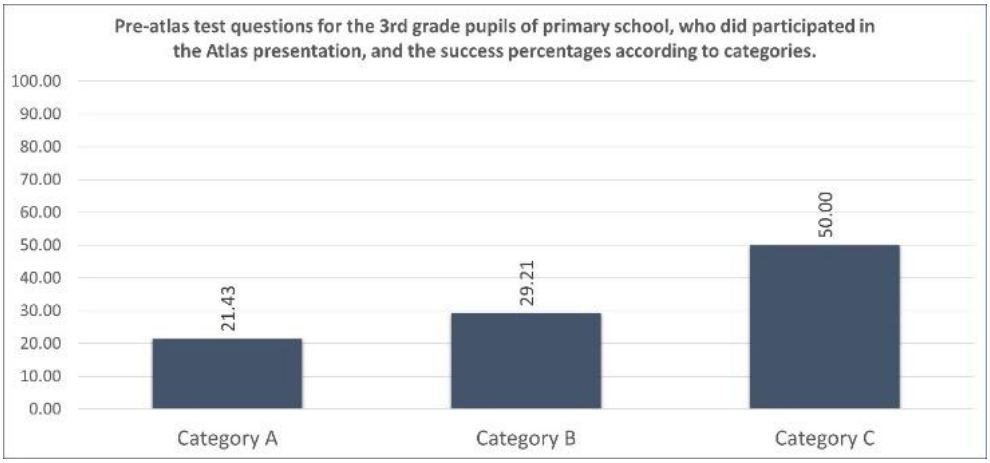

Figure 2. Pre-atlas test questions for the 3rd-grade pupils according to categories, who did participate in the Atlas presentation, and the success percentages are represented with a chart

Considering the outcomes presented in the preliminary tables pertaining to the pre-atlas assessment, it is evident that the cohort of female pupils in the third-grade cohort attained an accuracy rate of 30.33%, while their male counterparts in the same grade achieved a slightly lower accuracy rate of 29.70%.

A comprehensive preliminary examination focusing on fundamental knowledge regarding the Atlas was undertaken, involving the engagement of 140 fourth-grade pupils from a primary school who participated in an atlas presentation, forming the experimental cohort. It is paramount to highlight that the percentages illustrated in the subsequent table represent the ratio of accurate affirmative responses supplied by the pupils. Following the conclusion of the preliminary evaluation for primary school pupils, the findings derived from this assessment are elucidated in the ensuing table:

Table 5. An overview of the pre-atlas test questions administered to fourth-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Question 1	66.43 %
Question 2	48.57 %
Question 3	20.71 %
Question 4	20.71 %
Question 5	77.86 %
Question 6	12.86 %
Question 7	37.86 %
Question 8	77.86 %
Question 9	46.43 %
Question 10	25.00 %
Question 11	57.14 %
Question 12	29.29 %
Question 13	16.43 %
Question 14	45.71 %
Question 15	17.86 %

As per the information presented in the provided tabular data, it can be inferred that questions number 5 and number 8 manifest the highest mean percentage of accurate responses, reaching 77.86%. In contrast, question 6 illustrates the lowest mean percentage of accurate responses, registering at 12.86%.

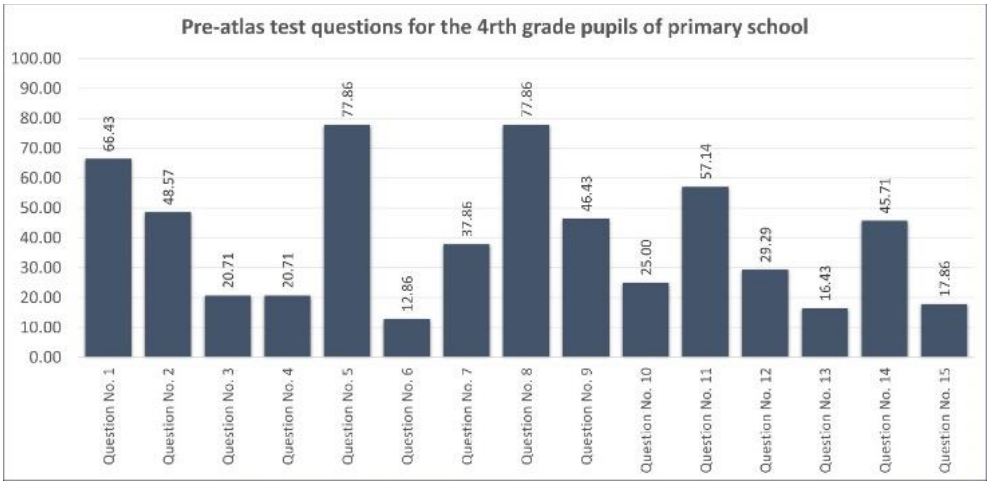

Figure 3. Pre-atlas test questions for the 4rth grade pupils who did participate in the Atlas presentation and the success percentages are represented with a chart

The ensuing pre-atlas test was carried out on fourth-grade pupils, involving 15 carefully formulated inquiries. These questions were categorized into three domains: A) Concepts related to Maps and Atlases, B) Comprehension of Directions, geographical regions, and neighboring areas, and C) Understanding of Tourism and Economy in North Macedonia. The subsequent table offers a detailed summary of the outcomes corresponding to these specific categories for fourth-grade pupils:

Table 6. An overview of the pre-atlas test questions of categories administered to fourth-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Category A	17.86 %
Category B	40.44 %
Category C	57.14 %

Derived from the information delineated in the presented tabular data, it is discernible that inquiries falling under Category C showcase the most elevated mean accuracy, attaining a value of 57.14%. Subsequently, queries classified under Category B also showcase a notable accuracy rate, totaling 40.44%. In contrast, questions categorized under Category A exhibit the lowest mean accuracy, sustaining a rate of 17.86%.

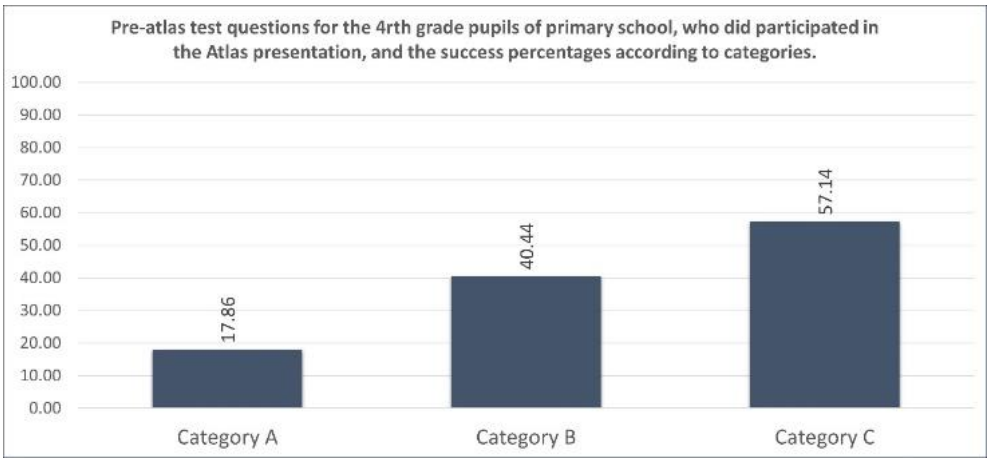

Figure 4. Pre-atlas test questions for the 4rth grade pupils who did participate in the Atlas presentation, according to categories, and the success percentages are represented with a chart

Considering the outcomes presented in the preliminary tables pertaining to the pre-atlas assessment, it is evident that the cohort of female pupils in the fourth-grade cohort attained an accuracy rate of 40.81%, while their male counterparts in the same grade achieved a slightly lower accuracy rate of 39.37%.

A thorough initial assessment focusing on basic knowledge related to the Atlas was carried out, including 153 fifth-grade pupils from a primary school who actively participated in an atlas presentation, forming the experimental cohort. It is essential to underscore that the percentages in the subsequent table signify the proportion of accurate affirmative responses the pupils gave. Following the conclusion of the preliminary assessment for primary school pupils, the outcomes derived from this evaluation are delineated in the ensuing table:

Table 7. An overview of the pre-atlas test questions administered to fifth-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Question 1	74.51 %
Question 2	19.61 %
Question 3	25.49 %
Question 4	43.14 %
Question 5	74.51 %
Question 6	20.92 %
Question 7	39.22 %
Question 8	64.71 %
Question 9	69.28 %
Question 10	54.90 %
Question 11	65.36 %
Question 12	25.49 %
Question 13	22.22 %
Question 14	38.56 %
Question 15	16.99 %

As per the information presented in the provided tabular data, it can be inferred that questions number 1 and number 5 manifest the highest mean percentage of accurate responses, reaching 74.51%. In contrast, question 15 illustrates the lowest mean percentage of accurate responses, registering at 16.99%.

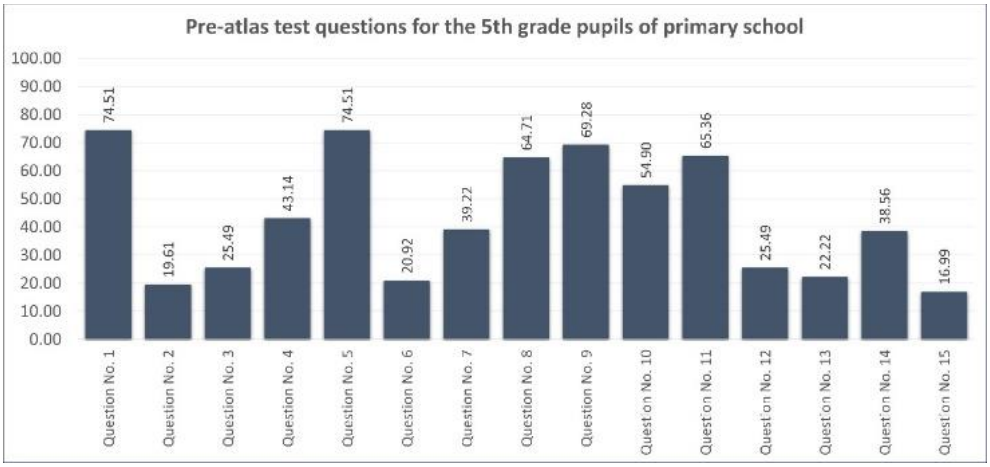

Figure 5. Pre-atlas test questions for the 5th grade pupils who did participate in the Atlas presentation and the success percentages are represented with a chart

The ensuing pre-atlas test was carried out on fourth-grade pupils, involving 15 carefully formulated inquiries. These questions were categorized into three domains: A) Concepts related to Maps and Atlases, B) Comprehension of Directions, geographical regions, and neighboring areas, and C) Understanding of Tourism and Economy in North Macedonia. The subsequent table offers a detailed summary of the outcomes corresponding to these specific categories for fifth-grade pupils:

Table 8. An overview of the pre-atlas test questions of categories administered to fifth-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Category A	16.99 %
Category B	44.04 %
Category C	65.36 %

Derived from the information delineated in the presented tabular data, it is discernible that inquiries falling under Category C showcase the most elevated mean accuracy, attaining a value of 65.36%. Subsequently, queries classified under Category B also showcase a notable accuracy rate, totaling 44.04%. In contrast, questions categorized under Category A exhibit the lowest mean accuracy, sustaining a rate of 16.99%.

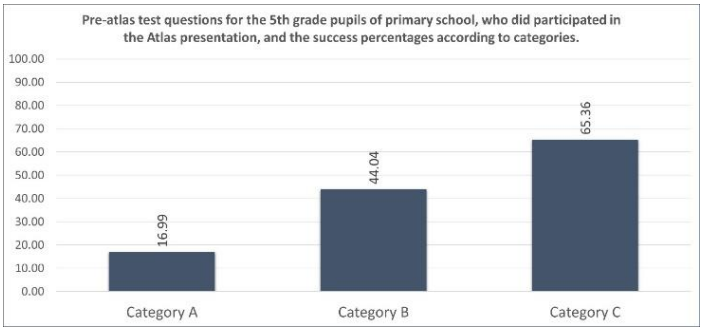

Figure 6. Pre-atlas test questions for the 5th-grade pupils who did participate in the Atlas presentation, according to categories, and the success percentages are represented with a chart

Considering the outcomes presented in the preliminary tables pertaining to the pre-atlas assessment, it is evident that the cohort of female pupils in the fifth-grade cohort attained an accuracy rate of 46.04%, while their male counterparts in the same grade achieved a slightly lower accuracy rate of 41.44%.

In this study, a comprehensive sample comprising 377 primary school pupils actively involved in the Atlas presentation and associated activities, from third to fifth grade and aged between 7 to 10 years, participated in a preliminary assessment designed to gauge their comprehensive understanding of the Atlas. These pupils also formed the experimental group that engaged in the atlas presentation. It is important to highlight that the percentages in the subsequent table are derived from the pupils' accurate affirmative responses. After the conclusion of the preliminary assessment for primary school pupils, the following table presents the outcomes obtained from this evaluation:

Table 9. An overview of the pre-atlas test questions administered to all primary school pupils (from 3rd grade to 5th grade) who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Question 1	58.49 %
Question 2	36.22 %
Question 3	18.97 %
Question 4	28.03 %
Question 5	67.85 %
Question 6	16.81 %
Question 7	34.42 %
Question 8	70.93 %
Question 9	50.87 %
Question 10	30.40 %
Question 11	57.50 %
Question 12	25.01 %
Question 13	16.85 %
Question 14	37.22 %
Question 15	18.76 %

As per the information in the provided tabular data, it can be inferred that question number 8 manifests the highest mean percentage of accurate responses, reaching 70.93%. In contrast, question 6 illustrates the lowest mean percentage of accurate responses, registering at 16.81%.

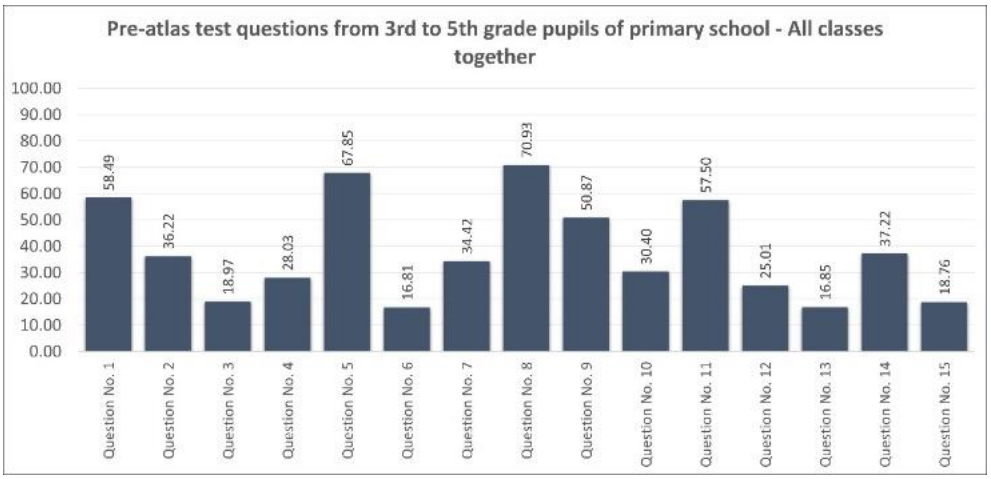

Figure 7. Pre-atlas test questions for all classes together (3rd to 5th-grade pupils) who did participate in the Atlas presentation and the success percentages are represented with a chart

The ensuing pre-atlas test was carried out on pupils from 3rd to 5th grade, involving 15 carefully formulated inquiries. These questions were categorized into three domains: A) Concepts related to Maps and Atlases, B) Comprehension of Directions, geographical regions, and neighboring areas, and C) Understanding of Tourism and Economy in North Macedonia. The subsequent table offers a detailed summary of the outcomes corresponding to these specific categories for fifth-grade pupils:

Table 10. An overview of the pre-atlas test questions of categories administered to all primary school pupils (from 3rd to 5th grade) who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Category A	18.76 %
Category B	37.90 %
Category C	57.50 %

Derived from the information delineated in the presented tabular data, it is discernible that inquiries falling under Category C showcase the most elevated mean accuracy, attaining a value of 57.50%. Subsequently, queries classified under Category B also showcase a notable accuracy rate, totaling 37.90%. In contrast, questions categorized under Category A exhibit the lowest mean accuracy, sustaining a rate of 18.76%.

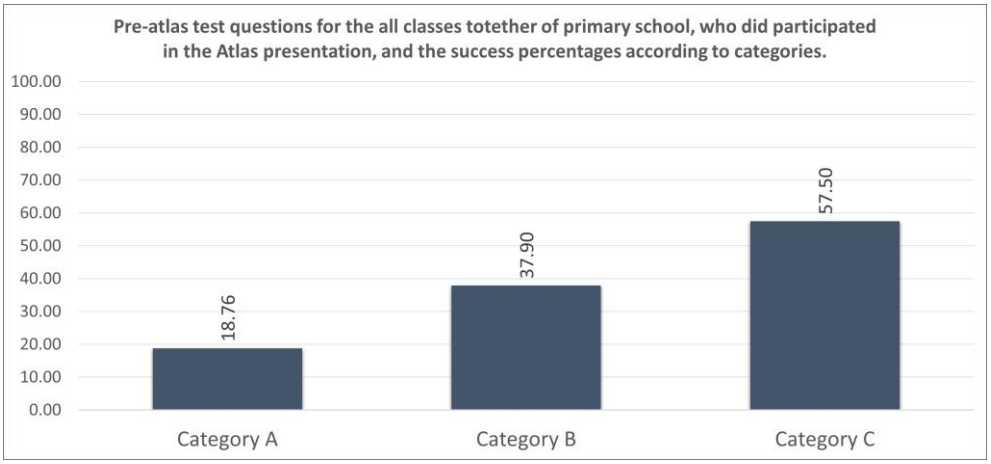

Figure 8. Pre-atlas test questions for all classes together (3rd to 5th-grade pupils) who did participate in the Atlas presentation, according to categories and the success percentages are represented with a chart

Considering the outcomes presented in the preliminary tables pertaining to the pre-atlas assessment, it is evident that the cohort of female pupils from the third to fifth grade cohort attained an accuracy rate of 39.06%, while their male counterparts in the same grade achieved a slightly lower accuracy rate of 36.84%.

3.1.2. Post-Atlas Test

A thorough post-atlas examination regarding general knowledge related to the Atlas was administered to a cohort of 84 third-grade primary school pupils who actively participated in the atlas presentation, forming the experimental group. These pupils were actively involved in the post-atlas test, which aimed to evaluate their overall understanding of the Atlas. It is crucial to emphasize that the percentages depicted in the subsequent table represent the outcomes obtained from accurate positive responses provided by the pupils. Following the conclusion of the pre-atlas test for primary school pupils, the results obtained from this identical assessment are presented in the tables below:

Table 11. An overview of the post-atlas test questions administered to third-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Question 1	70.23 %
Question 2	55.95 %
Question 3	26.19 %
Question 4	53.57 %
Question 5	35.71 %
Question 6	60.71 %
Question 7	51.19 %
Question 8	52.38 %
Question 9	75.00 %
Question 10	32.14 %
Question 11	52.38 %
Question 12	21.43 %
Question 13	69.05 %
Question 14	47.62 %
Question 15	51.19 %

As per the information in the provided tabular data, it can be inferred that question number 9 manifests the highest mean percentage of accurate responses, reaching 75.00%. In contrast, question 12 illustrates the lowest mean percentage of accurate responses, registering at 21.43%.

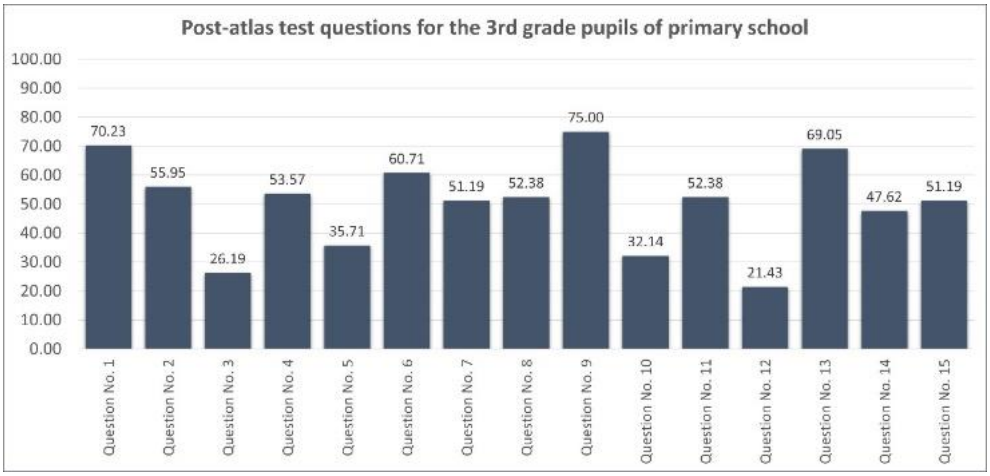

Figure 9. Post-atlas test questions for the 3rd-grade pupils who did participate in the Atlas presentation and the success percentages are represented with a chart

The ensuing post-atlas test was carried out on third-grade pupils, involving 15 carefully formulated inquiries. These questions were categorized into three domains: A) Concepts related to Maps and Atlases, B) Comprehension of Directions, geographical regions, and neighboring areas, and C) Understanding of Tourism and Economy in North Macedonia. The subsequent table offers a detailed summary of the outcomes corresponding to these specific categories for third-grade pupils:

Table 12. An overview of the post-atlas test questions of categories administered to third-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Category A	54.76 %
Category B	48.33 %
Category C	49.83 %

Derived from the information delineated in the presented tabular data, it is discernible that inquiries falling under Category A showcase the most elevated mean accuracy, attaining a value of 54.76%. Subsequently, queries classified under Category C also showcase a notable accuracy rate, totaling 49.83%. In contrast, questions categorized under Category B exhibit the lowest mean accuracy, sustaining a rate of 48.33%.

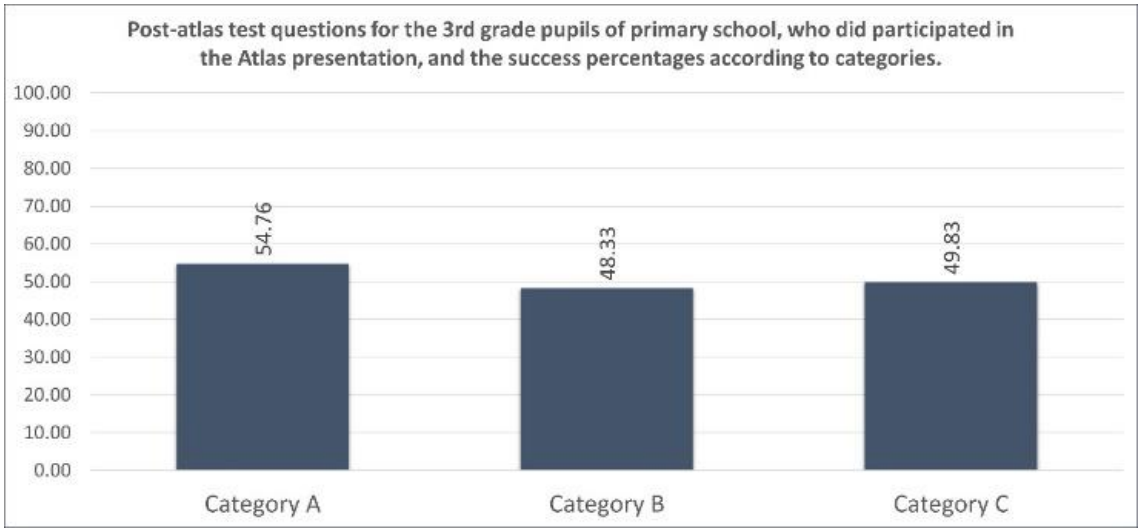

Figure 10. Post-atlas test questions for the 3rd-grade pupils who did participate in the Atlas presentation, according to categories, and the success percentages are represented with a chart

Considering the outcomes presented in the preliminary tables pertaining to the post-atlas assessment, it is evident that the cohort of female pupils in the third-grade cohort attained an accuracy rate of 57.67%, while their male counterparts in the same grade achieved a slightly lower accuracy rate of 57.21%.

An extensive post-atlas assessment regarding fundamental knowledge associated with the Atlas was carried out among 140 fourth-grade primary school pupils, all participated in the atlas presentation and comprised the experimental group. These pupils actively participated in the post-atlas test, which aimed to gauge their overall comprehension of the Atlas. It is vital to emphasize that the percentages depicted in the subsequent table represent the outcomes derived from accurate positive responses provided by the pupils. Following the conclusion of the pre-atlas test for primary school pupils, the results obtained from this identical assessment are presented in the tables below:

Table 13. An overview of the post-atlas test questions administered to fourth-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Question 1	69.29 %
Question 2	95.00 %
Question 3	44.29 %
Question 4	96.43 %
Question 5	88.57 %
Question 6	82.14 %
Question 7	92.14 %
Question 8	92.14 %
Question 9	87.86 %
Question 10	80.71 %
Question 11	85.00 %
Question 12	49.29 %
Question 13	90.00 %
Question 14	95.71 %
Question 15	90.00 %

As per the information in the provided tabular data, it can be inferred that query number 4 manifests the highest mean percentage of accurate responses, reaching 96.43%. In contrast, query number 3 illustrates the lowest mean percentage of accurate responses, registering at 44.29%.

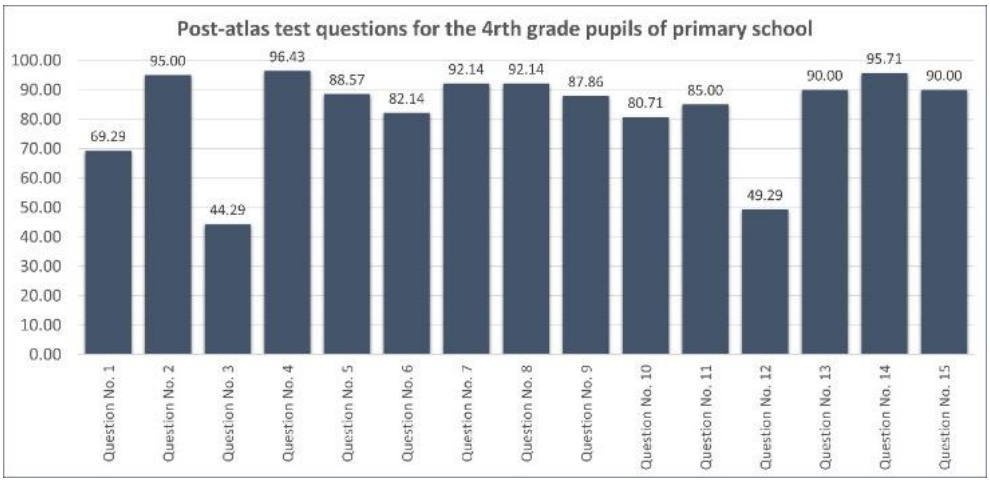

Figure 11. Post-atlas test questions for the 3rd-grade pupils who did participate in the Atlas presentation, according to categories, and the success percentages are represented with a chart

The ensuing post-atlas test was carried out on fourth-grade pupils, involving 15 carefully formulated inquiries. These questions were categorized into three domains: A) Concepts related to Maps and Atlases, B) Comprehension of Directions, geographical regions, and neighboring areas, and C) Understanding of Tourism and Economy in North Macedonia. The subsequent table offers a detailed summary of the outcomes corresponding to these specific categories for fourth-grade pupils:

Table 14. An overview of the post-atlas test questions of categories administered to fourth-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Category A	88.81 %
Category B	78.71 %
Category C	82.65 %

Derived from the information delineated in the presented tabular data, it is discernible that inquiries falling under Category A showcase the most elevated mean accuracy, attaining a value of 88.81%. Subsequently, queries classified under Category C also showcase a notable accuracy rate, totaling 82.65%. In contrast, questions categorized under Category B exhibit the lowest mean accuracy, sustaining a rate of 78.71%.

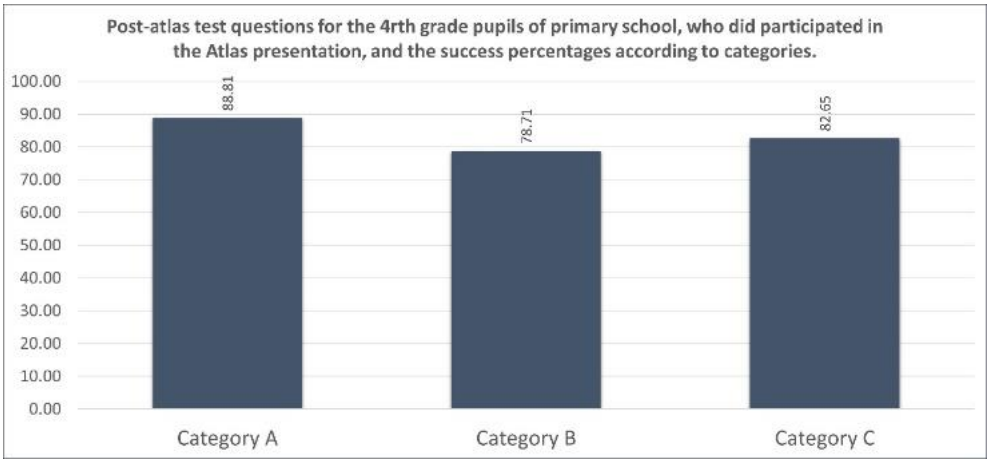

Figure 12. Post-atlas test questions for the 3rd-grade pupils who did participate in the Atlas presentation, according to categories, and the success percentages are represented with a chart

Considering the outcomes presented in the preliminary tables pertaining to the post-atlas assessment, it is evident that the cohort of female pupils in the fourth-grade cohort attained an accuracy rate of 83.64%, while their male counterparts in the same grade achieved a slightly lower accuracy rate of 81.62%.

A thorough post-atlas assessment concerning general knowledge associated with the Atlas was administered to 153 fifth-grade primary school pupils who participated in the atlas presentation, constituting the experimental group. These pupils actively participated in the post-atlas test to evaluate their overall understanding of the Atlas. It is crucial to emphasize that the percentages depicted in the subsequent table represent the outcomes derived from accurate positive responses provided by the pupils. Following the completion of the pre-atlas test for primary school pupils, the results obtained from this identical assessment are presented in the tables below:

Table 15. An overview of the post-atlas test questions administered to fifth-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Question 1	71.24 %
Question 2	92.16 %
Question 3	48.37 %
Question 4	96.73 %
Question 5	54.90 %
Question 6	81.05 %
Question 7	90.20 %
Question 8	82.35 %
Question 9	87.58 %
Question 10	45.75 %
Question 11	75.16 %
Question 12	28.11 %
Question 13	92.81 %
Question 14	90.17 %
Question 15	92.16 %

As per the information in the provided tabular data, it can be inferred that query number 4 manifests the highest mean percentage of accurate responses, reaching 96.73%. In contrast, query 12 illustrates the lowest mean percentage of accurate responses, registering at 28.11%.

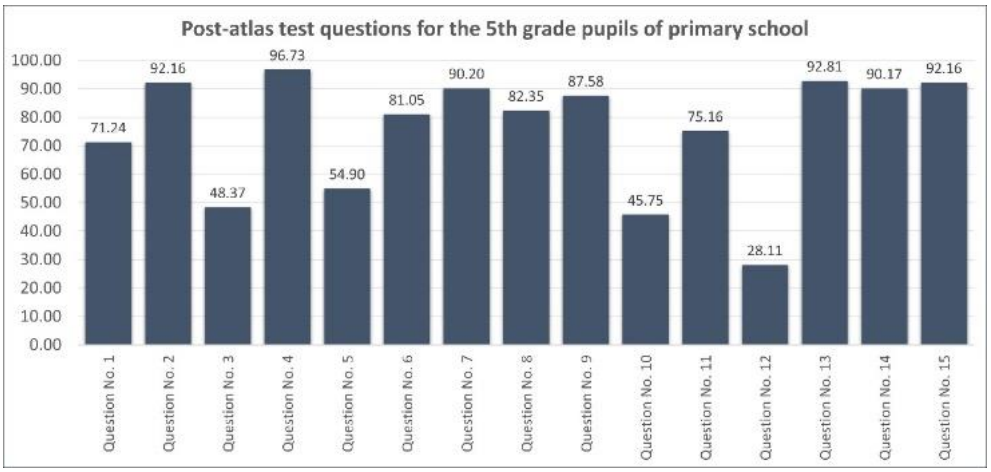

Figure 13. Post-atlas test questions for the 5th-grade pupils who did participate in the Atlas presentation and the success percentages are represented with a chart

The ensuing post-atlas test was carried out on fifth-grade pupils, involving 15 carefully formulated inquiries. These questions were categorized into three domains: A) Concepts related to Maps and Atlases, B) Comprehension of Directions, geographical regions, and neighboring areas, and C) Understanding of Tourism and Economy in North Macedonia. The subsequent table offers a detailed summary of the outcomes corresponding to these specific categories for fourth-grade pupils:

Table 16. An overview of the post-atlas test questions of categories administered to fifth-grade primary school pupils who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Category A	84.53 %
Category B	72.68 %
Category C	73.11 %

Derived from the information delineated in the presented tabular data, it is discernible that inquiries falling under Category A showcase the most elevated mean accuracy, attaining a value of 84.53%. Subsequently, queries classified under Category C also showcase a notable accuracy rate, totaling 73.11%. In contrast, questions categorized under Category B exhibit the lowest mean accuracy, sustaining a rate of 72.68%.

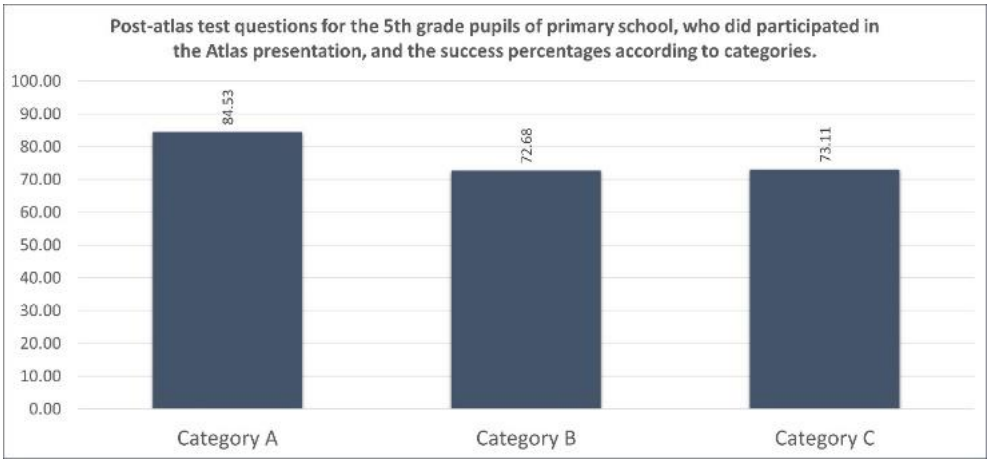

Figure 14. Post-atlas test questions for the 5th-grade pupils who did participate in the Atlas presentation and the success percentages are represented with a chart

Considering the outcomes presented in the preliminary tables pertaining to the post-atlas assessment, it is evident that the cohort of female pupils in the fifth-grade cohort attained an accuracy rate of 75.95%, while their male counterparts in the same grade achieved a slightly lower accuracy rate of 74.60%.

In this study, a comprehensive sample comprising 377 primary school pupils actively involved in the Atlas presentation and related activities, from the third to fifth grade and aged between 7 to 10 years, participated in a post-atlas test to evaluate their comprehensive understanding of the Atlas. These pupils also formed the experimental group that engaged in the atlas presentation. It is important to note that the percentages depicted in the subsequent table are derived from the pupils' accurate affirmative responses. Following the completion of the post-atlas test for primary school pupils, the following table presents the outcomes obtained from this evaluation:

Table 17. An overview of the post-atlas test questions administered to all primary school pupils (from 3rd grade to 5th grade) who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Question 1	70.26 %
Question 2	81.04 %
Question 3	39.61 %
Question 4	82.24 %
Question 5	59.73 %
Question 6	74.63 %
Question 7	77.84 %
Question 8	75.63 %
Question 9	83.48 %
Question 10	52.87 %
Question 11	70.85 %
Question 12	32.94 %
Question 13	83.95 %
Question 14	77.84 %
Question 15	77.78 %

As per the information in the provided tabular data, it can be inferred that query number 13 manifests the highest mean percentage of accurate responses, reaching 83.95%. In contrast, query 12 illustrates the lowest mean percentage of accurate responses, registering at 32.94%.

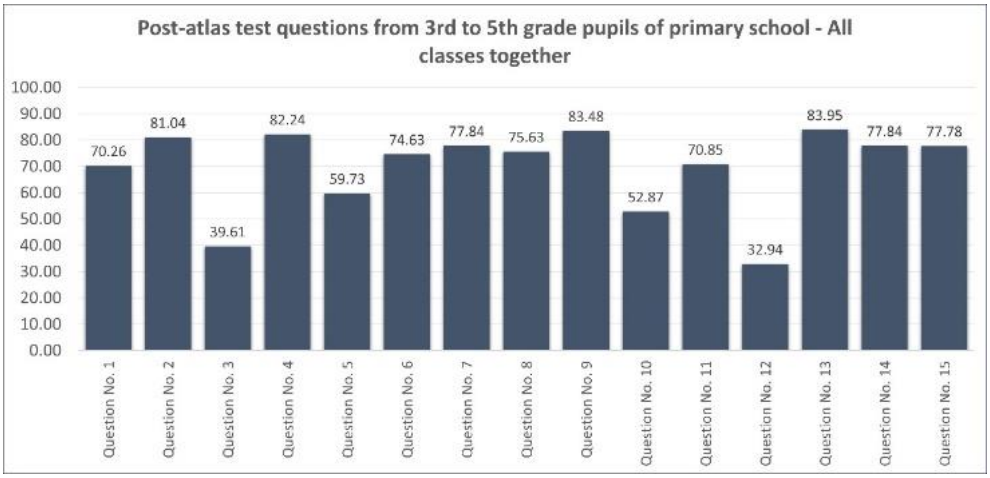

Figure 15. Post-atlas test questions for the 5th-grade pupils who did participate in the Atlas presentation and the success percentages are represented with a chart

The ensuing post-atlas test was carried out on pupils from 3rd to 5th grade, involving 15 carefully formulated inquiries. These questions were categorized into three domains: A) Concepts related to Maps and Atlases, B) Comprehension of Directions, geographical regions, and neighboring areas, and C) Understanding of Tourism

and Economy in North Macedonia. The subsequent table offers a detailed summary of the outcomes corresponding to these specific categories for fifth-grade pupils:

Table 18. An overview of the post-atlas test questions of categories administered to all primary school pupils (from 3rd to 5th grade) who actively engaged in the Atlas presentation and associated exercises, along with the corresponding success percentages

Questions	Success Percentages %
Category A	76.03 %
Category B	66.58 %
Category C	68.53 %

Derived from the information delineated in the presented tabular data, it is discernible that inquiries falling under Category A showcase the most elevated mean accuracy, attaining a value of 76.03%. Subsequently, queries classified under Category C also showcase a notable accuracy rate, totaling 68.53%. In contrast, questions categorized under Category B exhibit the lowest mean accuracy, sustaining a rate of 66.58%.

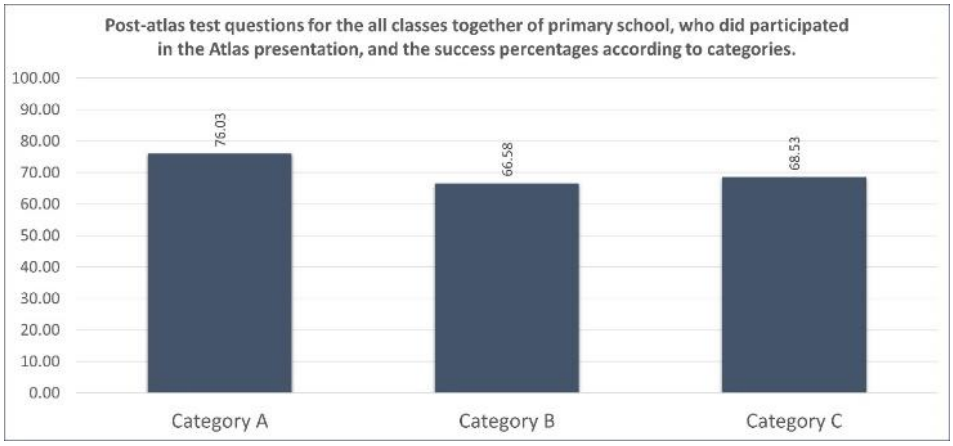

Figure 16. Post-atlas test questions for the 5th-grade pupils who did participate in the Atlas presentation and the success percentages are represented with a chart

Considering the outcomes presented in the preliminary tables pertaining to the post-atlas assessment, it is evident that the cohort of female pupils from the third to fifth grade cohort attained an accuracy rate of 72.42%, while their male counterparts in the same grade achieved a slightly lower accuracy rate of 70.84%.

T-tests were employed and calculated using Microsoft Excel to rigorously examine the significance of observed differences between distinct groups within our sample. The application of t-tests was pivotal in evaluating the effectiveness of the experimental intervention. This statistical approach, facilitated by Excel, enhances the reliability and validity of our findings, providing a robust basis for the conclusions drawn in this academic investigation. The following tables and descriptive texts related to the tables are presented as follows:

Table 19. Discoveries pertaining to the outcomes of pre-atlas and post-atlas assessments for third-grade pupils in primary education

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	84	30.08	17.10	2.15	0.002
Post Atlas	84	50.32	15.78		

The table presents a comparative analysis of academic performance before and after implementing the Atlas program in a primary school setting. Prior to the program, the average score among 377 pupils was 30.08 out of 100, with a standard deviation of 17.10. Post-implementation, there was a substantial increase in the average score to 50.32, accompanied by a higher standard deviation of 15.78. The calculated t-value of 2.15 indicates a statistically significant difference between pre-Atlas and post-Atlas test results, further supported by a p-value of 0.002, confirming the significance of the findings. These results underscore the efficacy of the Atlas program in enhancing pupil learning outcomes and highlight its importance in driving positive educational outcomes in primary school settings.

Table 20. Discoveries pertaining to the outcomes of pre-atlas and post-atlas assessments for third-grade pupils in primary education

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	140	40.05	22.16	2.15	0.00001
Post Atlas	140	82.57	16.12		

The provided table offers a comparative examination of academic performance metrics before and after the introduction of the Atlas program in a primary school context. Prior to the program, among 377 pupils, the average score was 40.05 out of 100, with a standard deviation of 22.16. Following the intervention, there was a notable enhancement in academic achievement, with the average score surging to 82.57 out of 100 and a decrease in the standard deviation to 16.12. The computed t-value of 2.15 indicates a statistically significant difference between pre-Atlas and post-Atlas assessment results, further supported by a p-value of 0.00001, affirming the substantial nature of the observed improvements. These findings highlight the efficacy of the Atlas program in augmenting pupil learning outcomes and emphasize its pivotal role in fostering positive educational advancements within primary school environments.

Table 21. Discoveries pertaining to the outcomes of pre-atlas and post-atlas assessments for third-grade pupils in primary education

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	153	43.66	21.67	2.15	0.002
Post Atlas	153	75.25	21.16		

The table presents a comparative analysis of academic performance before and after implementing the Atlas program in a primary school setting. Prior to the program, the average score among 377 pupils was 43.66 out of 100, with a standard deviation of 21.67. Post-implementation, there was a substantial increase in the average score to 75.25, accompanied by a higher standard deviation of 21.16. The calculated t-value of 2.15 indicates a statistically significant difference between pre-Atlas and post-Atlas test results, further supported by a p-value of 0.002, confirming the significance of the findings. These results underscore the efficacy of the Atlas program in enhancing pupil learning outcomes and highlight its importance in driving positive educational outcomes in primary school settings.

Table 22. Discoveries pertaining to the outcomes of pre-atlas and post-atlas assessments for third-grade pupils in primary education

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	377	37.93	18.72	2.15	0.0001
Post Atlas	377	69.38	15.98		

The provided table offers a comparative examination of academic performance metrics before and after the introduction of the Atlas program in a primary school context. Prior to the program, among 377 pupils, the average score was 37.93 out of 100, with a standard deviation of 18.72. Following the intervention, there was a notable enhancement in academic achievement, with the average score surging to 69.38 out of 100 and a decrease in the standard deviation to 15.98. The computed t-value of 2.15 indicates a statistically significant difference between pre-Atlas and post-Atlas assessment results, further supported by a p-value of 0.0001, affirming the substantial nature of the observed improvements. These findings highlight the efficacy of the Atlas program in augmenting pupil learning outcomes and emphasize its pivotal role in fostering positive educational advancements within primary school environments.

The findings presented based on the pre-test and post-test results with pupils that were part of the atlas presentation, through rigorous statistical analyses, underscore the effectiveness of the Atlas program in significantly improving academic performance among primary school pupils across multiple grade levels. The observed increases in average scores post-test implementation and notable decreases in standard deviations indicate a consistent pattern of enhanced learning outcomes attributed to the program. Furthermore, the statistically significant differences between pre-Atlas and post-Atlas test results, as evidenced by low p-values,

substantiate the impact of the intervention on fostering positive educational advancements. These results emphasize the pivotal role of the Atlas program in driving meaningful improvements in pupil learning outcomes and highlight its potential to contribute positively to educational practices within primary school settings. Future research endeavors should delve deeper into the mechanisms underlying these observed improvements to inform more targeted and effective educational interventions.

3.2. Discussion

By employing a comprehensive mixed-methods research design, this study seeks to thoroughly understand the effects of incorporating maps as educational tools in primary education. The development and testing of the pre-atlas and post-atlas tests ensure that the maps and accompanying information are suitable for primary school pupils, aligning with their cognitive abilities and spatial reasoning skills. The findings of this research will contribute empirical evidence on the advantages and challenges of using maps as educational tools, enabling educators, curriculum developers, and policymakers to make informed decisions and improve teaching practices. The pre-atlas and post-atlas tests are designed to assess pupils' knowledge and comprehension of the information presented on the maps within the Atlas. By analyzing the outcomes of these tests, a comparison can be drawn to assess the impact of the atlas on the enhancement of general knowledge, allowing for the presentation of results indicating the improvement achieved. This analysis provides valuable insights into the correlation between map usage and pupils' skill development, cognitive abilities, and overall academic performance. Furthermore, the analysis of the pre-atlas and post-atlas test data offers numerical findings that contribute to a statistical basis for understanding the impact of map utilization on spatial reasoning abilities, problem-solving skills, and pupil engagement and motivation. Additionally, the tests shed light on the challenges faced by educators, such as resource limitations and the need for adequate training. By combining these test data, this study aims to provide a comprehensive perspective on the advantages, challenges, and potential improvements related to integrating maps into primary education. Overall, the findings of this study are expected to inform educational practices, enhance the learning experiences of young learners, and promote the effective integration of maps into the primary education system. By establishing an evidence-based foundation, this research strives to maximize pupils' cognitive abilities, foster a comprehensive understanding of geographical concepts, and contribute to the overall efficacy of the educational system. With the conclusion of both the pre-atlas and post-atlas tests, the obtained results offer valuable insights into the evolving geographic awareness of primary school pupils, providing a foundation for informed pedagogical strategies and curricular improvements in geography education regarding the Republic of North Macedonia. The pre-test results revealed variations in the success percentages across different questions and categories. Remarkably, question number 8 consistently exhibited the highest average of correct answers among all the classes, reaching 70.93%, while question number 6 consistently demonstrated the lowest average at 16.81%. Additionally, analyzing the results based on category and grade levels showcased intriguing trends. Category C (Tourism and Economy in North Macedonia) consistently exhibited the highest mean accuracy at 47.50%. These findings contribute valuable insights into the geographic knowledge proficiency of primary school pupils and can inform future educational interventions to enhance geographical awareness and understanding. The post-test results also revealed variations in the success percentages across different questions; question number 13 consistently exhibited the highest average of correct answers between all the classes, reaching 83.95%, while question number 12 consistently demonstrated the lowest average at 32.94%. The highest mean accuracy was observed in questions pertaining to Map and Atlas concepts (Category A), with an average success rate of 76.03%. Conversely, questions categorized under Directions, geographical regions, and neighboring areas (Category B) demonstrated a comparatively lower mean accuracy of 66.58%. The study further identified notable differences in performance between female and male pupil groups, emphasizing the importance of considering gender dynamics in educational assessments. Overall, the findings underscore the need for targeted interventions to enhance geographic knowledge among primary school pupils, specifically focusing on areas with lower proficiency levels. Based on the findings derived from the pre-atlas test, it can be inferred that the academic performance of third-grade pupils exhibited a notable improvement of 20.24%.

Similarly, the fourth-grade pupils demonstrated a comparable improvement of 42.52% in their results. Furthermore, the fifth-grade pupils displayed a significant advancement of 31.59% in their academic outcomes. The results show that the collective progress or advancement of all the classes involved amounts to approximately 31.45%. Previous research by different authors has also aimed to demonstrate similar impacts. For instance, in Türkiye, Erol, in 2020 [43], conducted a study involving 206 pupils, where the mean score of pupils or students in public schools was reported as 38.12. Buğdaycı and Selvi conducted a study in 2021 [2] involving primary school pupils, revealing a notable enhancement of approximately 40% in children's knowledge performance following the utilization of maps and atlases. Furthermore, Buğdaycı and Çetinkaya [44] conducted one of the initial investigations in the field of cartography pertaining to Türkiye, focusing on enhancing disaster awareness among children. Their findings indicate a significant increase of approximately 39% in the knowledge levels of pupils following the intervention, as evidenced by test results. The observed improvements in academic performance among third-, fourth-, and fifth-grade pupils following the implementation of the Atlas program underscore its potential to enhance educational outcomes across multiple grade levels. These results suggest that incorporating interactive geographical tools like maps boosts pupils' spatial reasoning and problem-solving skills and increases their engagement and motivation in learning. Policymakers could consider these findings when designing curriculum frameworks prioritizing interactive and experiential learning methodologies. Policymakers can foster a more inclusive and effective educational environment by investing in similar educational interventions that cater to diverse learning styles and promote hands-on learning experiences. Moreover, the study highlights the importance of continuous teacher training and resource allocation to support the successful integration of innovative educational tools like maps into classroom instruction. These insights could guide future policymaking decisions aimed at improving educational quality and equitability across primary schools in North Macedonia, ultimately contributing to a more robust educational system capable of nurturing well-rounded and informed young learners.

4. Conclusion

This study aims to contribute significantly to the field of primary education by examining the impact of utilizing maps as educational tools for pupils or children. By providing empirical evidence on the positive effects of incorporating cartographic materials into the curriculum, the findings foster cognitive development and lead to improvements in the overall educational system. This research informs educators, curriculum developers, and policymakers about the benefits and challenges associated with integrating maps, guiding their efforts to enhance primary school education. Ultimately, the study seeks to promote effective teaching practices and enrich the learning experiences of young learners through the thoughtful implementation of maps as pedagogical resources. The findings can potentially drive positive change and advancements in primary education, benefiting pupils and the educational community.

In conclusion, using maps as pedagogical tools in primary education holds great potential for enhancing children's cognitive development and the overall effectiveness of the educational system. Incorporating maps into the curriculum can engage pupils in spatial thinking, improve problem-solving skills, and deepen their understanding of geographical concepts. However, limited empirical research has systematically examined the impact of maps on pupils' abilities and the educational framework. Therefore, this study addresses this gap by investigating the effects of utilizing maps for children and highlighting their potential benefits for both pupils and the primary school education system. This study was conducted as part of a project focused on compiling and designing an atlas for primary school pupils between the ages of 7 and 10 in the Republic of North Macedonia. 377 primary school pupils, ranging from third to fifth grade, participated in this study.

Additionally, including a diverse sample of primary school pupils spanning grades 3 to 5 and stratified by gender allowed for a comprehensive analysis of geographic knowledge acquisition, shedding light on gender dynamics in educational assessments and the importance of considering these dynamics in pedagogical strategies. The testing process took place in four different schools in the city of Tetovo, North Macedonia, comprising three urban schools and one school in a peripheral village surrounding the city. The results obtained

from the pre-atlas test and post-atlas test were positive. Based on the outcomes of these tests, it can be concluded that incorporating maps into the educational system and lessons enhances learning and proficiency among pupils by around 31.45%. Additionally, it increases the effectiveness and efficiency of the learning process. Using cartographic materials such as maps and atlases in the classroom improves the quality of education and fosters pupils' engagement and participation. The empirical evidence presented in this study supports the effective integration of maps as educational tools in primary education, offering valuable insights for educators, curriculum developers, and policymakers. By fostering a comprehensive understanding of geographical concepts and maximizing pupils' cognitive abilities, the integration of maps holds great potential to enhance the learning experiences of young learners and contribute to the overall efficacy of the educational system.

Author Contributions

All the authors equally contributed to this work. This paper is derived from the first author's master's thesis, supervised by the second author. They all read and approved the final version of the paper.

Conflicts of Interest

All the authors declare no conflict of interest.

Ethical Review and Approval

No approval from the Board of Ethics is required.

Acknowledgment

This work was supported by the Office of Scientific Research Projects Coordination at Necmettin Erbakan University, Grand number: 23YL19002.

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