Afyon Kocatepe Üniversitesi Fen ve Mühendislik Bilimleri Dergisi
Afyon Kocatepe University – Journal of Science and Engineering
https://dergipark.org.tr/tr/pub/akufemubid

Araştırma Makalesi / Research Article
DOI: https://doi.org/10.35414/akufemubid.1419583
AKÜ FEMÜBİD 24 (2024) 045501 (847-865)
AKU J. Sci. Eng. 24 (2024) 045501 (847-865)

Assessment Spatial Perception Skills of Primary School Pupils: A Case Study at North Macedonia

*Makale Bilgisi / Article Info
Alındı/Received: 14.01.2024
Kabul/Accepted: 13.06.2024
Yayımlandı/Published: 20.08.2024

İlkokul Öğrencilerin Mekansal Algılama Becerilerinin Değerlendirilmesi: Kuzey Makedonya Örneği

Edmond JONUZİ *, **Hüseyin Zahit SELVİ**

Necmettin Erbakan University, Engineering Faculty, Department of Geomatics Engineering, 42090, Konya, Türkiye

Öz

Bu çalışmada, 3 ila 5. sınıf arasındaki ilkokul öğrencilerinin mekânsal algılama becerisi Kuzey Makedonya Cumhuriyeti örnek uygulamasıyla kapsamlı bir şekilde değerlendirilmiştir. Değerlendirme, öğrenci yaş grubu dikkate alınarak hazırlanan ön test ve son testler kullanılarak yapılmıştır. Sorular Harita ve Atlas kavramları (A Kategorisi), Yönler, coğrafi bölgeler ve komşu alanlar (B Kategorisi) ve Kuzey Makedonya'da Turizm ve Ekonomi (C Kategorisi) olmak üzere 3 kategoriye ayrılmıştır. Cinsiyet ve sınıf düzeyine dayalı potansiyel farklılıklar göz önünde bulundurularak öğrencilerin coğrafya ve harita okuma, alanındaki durumlarını tespit etmek ve bu alanlardaki becerilerini geliştirmek için neler yapılabileceğini ortaya koymak amaçlanmıştır. Bu amaçla 339 katılımcıyla testler yapılmış ve ilginç sonuçlar ortaya konmuştur. Çalışmada, kategoriler ve sorular arasında değişen başarı oranlarını gösteren hem güçlü hem de zayıf yönler vurgulanmıştır. Ek olarak, coğrafi bilgide cinsiyete özgü ve sınıf düzeyine bağlı farklılıklar ortaya çıkarılmıştır. Bu bulgular, mevcut coğrafya ve mekânsal eğitim yaklaşımlarının genç öğrenciler için etkililiği hakkında değerli çıkarımlar sunmakta olup, özellikle ilkokulun alt sınıflarında haritaların ve atlasların entegrasyonu ve kullanımı yoluyla mekânsal farkındalığı ve coğrafi okuryazarlığı artırmak için çalışma yapılmasının gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: *İlkokul Eğitimi; Mekânsal Farkındalık; Coğrafi Okuryazarlık; Haritalar; Atlaslar; Coğrafi Algıda Cinsiyet Farklılıklar.*

Abstract

This research conducted a thorough evaluation of the geographical knowledge of primary school pupils in grades 3 to 5, focusing on the Republic of North Macedonia. The assessment involved a carefully crafted pre-atlas and post-atlas test, categorizing questions into Map and Atlas concepts (Category A), Directions, geographical regions, and neighboring areas (Category B), and Tourism and Economy in North Macedonia (Category C). The objective was to gauge pupils' proficiency in various aspects of geography and map reading, while considering potential variations based on gender and grade level. The results, based on the accurate responses of 339 participants, revealed interesting patterns in knowledge distribution. The study highlighted both strengths and weaknesses, indicating varying success rates across categories and questions. Additionally, it unveiled gender-specific and grade-dependent differences in geographical knowledge. These findings offer valuable insights into the efficacy of current geography and spatial education approaches for young learners, emphasizing the necessity for targeted interventions to enhance spatial awareness and geographical literacy in primary education, especially primarily through the incorporation and utilization of maps and atlases within the lower grades of primary schools.

Keywords: *Primary Education; Spatial Awareness; Geographical Literacy; Maps; Atlases; Gender Differences in Geographical Perception.*

1. Introduction

Maps, as primary embodiments of cartographic representation, are ubiquitously available, enjoying widespread popularity and appeal across diverse fields and disciplines, and are utilized within the educational system to support various pedagogical endeavors (Bugdayci and Selvi 2017, Bugdayci and Selvi 2021, Robertson and Gerber 2000, Bandrova and Deleva 1998). The widespread use of maps as a method for visualizing spatial information is attributed to their ability to effectively represent the spatial distribution of selected information, providing a novel perspective (van Dijk et al. 1994). The growing prevalence of maps and the evolution of cartography as a scientific discipline underscore the heightened necessity to cultivate pupils' and students' map skills, encompassing proficiency in both the utilization and creation of maps (Havelkova and Hanus 2019). Proficiency in map usage not only enhances the interpretation of spatial information about the globe and one's local environment but also contributes significantly to geographical competence, meeting diverse needs in business, government, non-profit sectors, and the geospatial technology industry (Harte and Dunbar 1994, Catling 2005, Gökçe 2015, Hanus and Havelková 2019, DiBiase et al. 2010, Schulze et al. 2011, Solem et al. 2008, Solem 2016). The interdisciplinary fascination with cognitive mapping, involving geography, cartography, psychology, planning, and architecture, underscores its

*Sorumlu Yazar/Corresponding Author: Edmund Jonuzi e-posta/e-mail: edmondjonuzi1@gmail.com

fundamental importance as it pertains to spatial knowledge acquisition and organization, shaping individuals' experiences, attitudes, and behaviors in their environment (MacEachren 1992). Theoretical analysis indicates that consistent use of maps in geography lessons enhances pupils' success in understanding cartographic concepts (Gökçe 2015). Geographic knowledge, derived from thinking and reasoning about the world's natural and human phenomena, serves a dual purpose: establishing spatial locations and aiding decision-making and problem-solving through spatial memory (Golledge 2002). Spatial thinking involves utilizing spatial concepts, maps, and graphs, alongside reasoning processes, to organize and solve problems, demonstrating a combination of knowledge, skills, and habits of mind. The deliberate and systematic development of map-reading methods is essential for acquiring cartographic competence and fostering cognitive activity in pupils (Nazarenko et al. 2021). Cartography serves as a potent and influential medium for effective communication (Bandrova and Deleva 1999). Cartographic visualization, integral to user orientation, is intricately linked to the state of source databases, decision-supporting models, and user behavior and needs within the information transfer process (Koencny 2011). Teaching about and with maps encompasses imparting skills for map reading, interpretation, and production, as well as utilizing maps to facilitate learning key social studies concepts, encouraging spatial thinking, and applying this knowledge in reasoning and problem-solving contexts both in the classroom and the real world (Gattis 2003). The primary responsibility of a teacher initiating an environmental exploration program for young children is to personally engage in exploring the environment (Mitchell 1991). Despite skepticism among parents and teachers regarding young children's map comprehension, research indicates that even elementary school pupils are proficient in effectively using maps and remotely sensed images to navigate and trace routes to familiar destinations (National Research Council 2006).

The primary objective of this study is to comprehensively evaluate the general knowledge of primary school pupils, specifically those in the 3rd to 5th-grades, concerning the Republic of North Macedonia. The study sought to fill a critical gap in the existing literature by employing a pre-atlas and post-atlas test as a robust assessment tool. By categorizing the questions into Map and Atlas concepts, directions, geographical regions, neighboring areas, and Tourism and Economy in North Macedonia, as well as based on related social sciences, the research aims to discern the nuanced aspects of the pupils' geographical knowledge and spatial knowledge and general knowledge related to North Macedonia as well. Furthermore, the study aims to investigate potential variations in knowledge levels based on gender and grade level. This investigation was prompted by the importance of early geography education in shaping a foundational understanding of one's surroundings and fostering spatial awareness. The findings of this study contribute to the broader discourse on the efficacy of geography education strategies and social sciences strategies for young learners and provide valuable insights for teachers and curriculum developers seeking to enhance geographical literacy in primary education, including the integration of maps and atlases in the most prominent form. This study constitutes a distinct component of the primary author's diploma project. Within the diploma study, the examined pupils, who interacted with the prepared maps and the atlas titled "Atlas of the Republic of North Macedonia for Primary School Pupils," were categorized into two groups. The first group comprises pupils who underwent testing without being exposed to the maps and atlas presentation, meaning they did not encounter the mentioned product, commonly referred to as the control group. Conversely, the second group includes pupils who underwent testing after participating in the maps and atlas presentation, involving exposure to the atlas and engaging in various exercises and practices, commonly referred to as the experimental group. The post-atlas test represented within this article was administered to the control group, comprising pupils who did not partake in the atlas presentation and associated practices.

2. Materials and Methods

2.1. Participants

The study included a sample of 339 primary school pupils, aged 7 to 10 years, from the 3rd to the 5th-grade. The participants were stratified into three cohorts based on their grade level, as follows: 71 pupils from the 3rd-grade, 131 pupils from the 4th-grade, and 137 pupils from the 5th-grade. The sample consisted of 160 female and 179 male pupils.

2.2. Study Design

This study employed a cross-sectional design to assess the general knowledge of primary school pupils from the 3rd to the 5th-grade regarding the Republic of North Macedonia, utilizing a pre-atlas and a post-atlas test. The tests comprised 15 questions, categorized into Map and Atlas concepts (Category A), Directions, geographical regions, and neighboring areas (Category B), and Tourism and Economy in North Macedonia (Category C).

2.3. Data Collection and Statistical Analysis

Closed-ended questions with multiple-choice responses were used in the tests. Accuracy percentages were calculated, and results were organized into tables and charts. Descriptive statistics, including mean accuracy percentages and standard deviations, were computed, and stratified by grade level and also gender of the pupils. The T-test was systematically employed as an integral component of the present investigation.

3. Results and Discussions

3.1. Pre-atlas test questions

A comprehensive pre-atlas test on general knowledge related to the Atlas was conducted with the primary school pupils, involving the participation of 71 primary school pupils from the 3rd-grade, specifically comprising pupils aged 7 and 8 years, were categorized and stratified into two cohorts: the female group, consisting of 35 participants, and the male group, comprising 36 participants.

Table 1. Pre-atlas test questions for the 3rd-grade pupils of primary school, and the success percentages.

	Questions	Success percentages
1.	Which of these states does the Republic of North Macedonia not share a border with?	40.85 %
2.	What is the number of regions in the Republic of North Macedonia?	40.85 %
3.	In which region of North Macedonia does the city of Bitola belong?	12.68 %
4.	What is the number of cities in the Republic of North Macedonia?	21.13 %
5.	What is the capital city of the Republic of North Macedonia?	52.11 %
6.	What is the number of municipalities in the Republic of North Macedonia?	16.90 %
7.	How many natural lakes does North Macedonia have?	26.76 %
8.	What is the largest natural lake in North Macedonia?	74.65 %
9.	What is the largest river in North Macedonia?	38.03 %
10.	What is the highest mountain in North Macedonia?	11.27 %
11.	What is the symbol of the city of Skopje?	54.93 %
12.	Which state does North Macedonia share a border with in the east?	21.13 %
13.	What is the largest plain in the Republic of North Macedonia?	14.09 %
14.	The relief of the Republic of North Macedonia is predominantly characterized by?	22.54 %
15.	What is the resident population count in the Republic of North Macedonia?	21.13 %

It is of utmost importance to highlight that the percentages presented in the subsequent table are derived from the accurate positive responses provided by the pupils. With the completion of the pre-atlas test for primary school pupils, the ensuing Table 1 illustrates the outcomes obtained from this assessment

According to Table 1, it can be deduced that question number 8 exhibits the highest average of correct answers, amounting to 74.65%. Conversely, question number 10 demonstrates the lowest average of correct answers, also standing at 11.27%, which can also be seen in Figure 1.

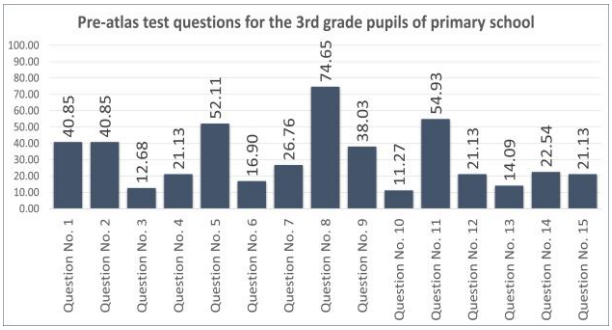

Figure 1. Pre-atlas test questions for the 3rd-grade pupils, and the success percentages are represented with a chart.

The pre-test comprising 15 questions was administered to assess the existing proficiency of the pupils of the 3rd-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The pre-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories for the 3rd-grade pupils are detailed in Table 2. Based on the data presented in Table 2, it can be inferred that questions within Category C exhibit the highest mean accuracy, registering at 54.93%. Following this, questions categorized under Category B also demonstrate an accuracy rate of 30.23%. Conversely, Category A questions yield the lowest mean accuracy, maintaining a rate of 21.13%, which can also be seen in Figure 2.

Table 2. Pre-atlas test questions for the 3rd-grade pupils of primary school, and the success percentages according to categories.

Category	Questions	Success percentages
A	What is the resident population count in the Republic of North Macedonia?	21.13 %
B	Which of these states does the Republic of North Macedonia not share a border with?	30.23 %
	What is the number of regions in the Republic of North Macedonia?	
	In which region of North Macedonia does the city of Bitola belong?	
	What is the number of cities in the Republic of North Macedonia?	
	What is the capital city of the Republic of North Macedonia?	
	What is the number of municipalities in the Republic of North Macedonia?	
	How many natural lakes does North Macedonia have?	
	What is the largest natural lake in North Macedonia?	
	What is the largest river in North Macedonia?	
	What is the highest mountain in North Macedonia?	
	Which state does North Macedonia share a border with in the east?	
	What is the largest plain in the Republic of North Macedonia?	
	The relief of the Republic of North Macedonia is predominantly characterized by?	
C	What is the symbol of the city of Skopje?	54.93 %

Table 3. Pre-atlas test questions for the 4-grade pupils of primary school, and the success percentages.

	Questions	Success percentages
1.	Which of these states does the Republic of North Macedonia not share a border with?	64.86 %
2.	What is the number of regions in the Republic of North Macedonia?	45.04 %
3.	In which region of North Macedonia does the city of Bitola belong?	21.37 %
4.	What is the number of cities in the Republic of North Macedonia?	19.85 %
5.	What is the capital city of the Republic of North Macedonia?	77.10 %
6.	What is the number of municipalities in the Republic of North Macedonia?	12.21 %
7.	How many natural lakes does North Macedonia have?	36.64 %
8.	What is the largest natural lake in North Macedonia?	79.39 %
9.	What is the largest river in North Macedonia?	43.51 %
10.	What is the highest mountain in North Macedonia?	21.37 %
11.	What is the symbol of the city of Skopje?	57.25 %
12.	Which state does North Macedonia share a border with in the east?	25.19 %
13.	What is the largest plain in the Republic of North Macedonia?	16.03 %
14.	The relief of the Republic of North Macedonia is predominantly characterized by?	44.27 %
15.	What is the resident population count in the Republic of North Macedonia?	17.58 %

Based on the results provided in the initial tables related to the pre-atlas test, the female pupil's group of the 3rd-class achieved an accuracy rate of 31.05%, whereas the male pupil's group of the 3rd achieved an accuracy rate of 31.30%.

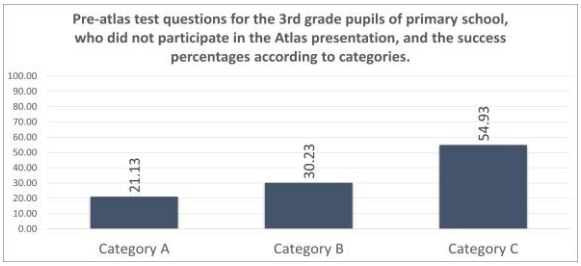

Figure 2. Pre-atlas test questions for the 3rd-grade pupils according to categories, and the success percentages are represented with a chart.

The pre-atlas test assessing general knowledge pertinent to the Atlas involved the participation of 131 primary school pupils, from the 4th-grade, specifically aged 8 and 9 years, categorized and stratified into two cohorts: the female group, consisting of 61 participants, and the male group, comprising 70 participants. It is essential to highlight that the percentages presented in the subsequent table are determined by the accurate positive responses provided by the pupils. With the culmination of the pre-atlas test for primary school pupils, the ensuing Table 3 displays the results acquired from this assessment. According to Table 3, it can be deduced that question number 8 exhibits the highest average of correct answers, amounting to 79.39%. Conversely, question number 6 demonstrates the lowest average of correct answers, also standing at 12.21%, which can also be seen in Figure 3.

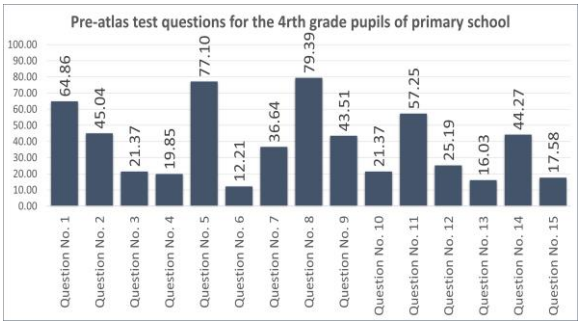

Figure 3. Pre-atlas test questions for the 4th-grade pupils and the success percentages are represented with a chart.

Table 4. Pre-atlas test questions for the 4th-grade pupils of primary school, and the success percentages according to categories.

Category	Questions	Success percentages
A	What is the resident population count in the Republic of North Macedonia?	17.56 %
B	Which of these states does the Republic of North Macedonia not share a border with?	38.99 %
	What is the number of regions in the Republic of North Macedonia?	
	In which region of North Macedonia does the city of Bitola belong?	
	What is the number of cities in the Republic of North Macedonia?	
	What is the capital city of the Republic of North Macedonia?	
	What is the number of municipalities in the Republic of North Macedonia?	
	How many natural lakes does North Macedonia have?	
	What is the largest natural lake in North Macedonia?	
	What is the largest river in North Macedonia?	
	What is the highest mountain in North Macedonia?	
	Which state does North Macedonia share a border with in the east?	
	What is the largest plain in the Republic of North Macedonia?	
	The relief of the Republic of North Macedonia is predominantly characterized by?	
C	What is the symbol of the city of Skopje?	57.25 %

The pre-test comprising 15 questions was administered to assess the existing proficiency of the pupils of the 4th-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The pre-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories for the 4th-grade pupils are detailed in Table 4.

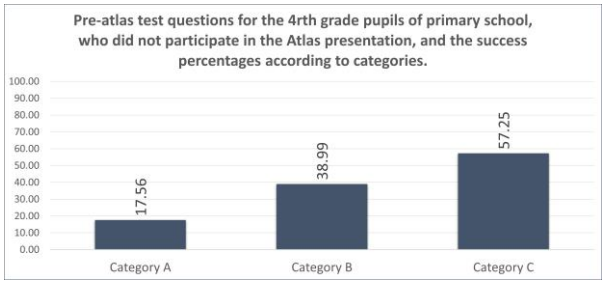

Figure 4. Pre-atlas test questions for the 4th-grade pupils according to categories, and the success percentages are represented with a chart.

Based on the data presented in Table 4, it can be inferred that questions within Category C exhibit the highest mean accuracy, registering at 57.25%. Following this, questions categorized under Category B also demonstrate an accuracy rate of 38.99%. Conversely. Category A questions yield the lowest mean accuracy, maintaining a rate of 17.56%, which can also be seen in Figure 4. Based on the results provided in the initial tables related to the pre-atlas test, the female pupil's group of the 4th-class achieved an accuracy rate of 40.00%, whereas the male pupil's group of the 4th-class achieved an accuracy rate of 37.71%.

A collective of 137 primary school pupils from the 5th-grade, specifically aged between 9 and 10 years, were categorized and stratified into two cohorts: the female group, consisting of 64 participants, and the male group, comprising 73 participants. It is imperative to underscore that the percentages presented in the subsequent table are contingent upon the accurate positive responses provided by the pupils. With the conclusion of the pre-atlas test for primary school pupils, the ensuing Table 5 presents the results obtained from this evaluation.

Table 5. Pre-atlas test questions for the 5th-grade pupils of primary school, and the success percentages.

	Questions	Success percentages
1.	Which of these states does the Republic of North Macedonia not share a border with?	71.53 %
2.	What is the number of regions in the Republic of North Macedonia?	21.17 %
3.	In which region of North Macedonia does the city of Bitola belong?	20.44 %
4.	What is the number of cities in the Republic of North Macedonia?	40.15 %
5.	What is the capital city of the Republic of North Macedonia?	73.72 %
6.	What is the number of municipalities in the Republic of North Macedonia?	18.25 %
7.	How many natural lakes does North Macedonia have?	35.04 %
8.	What is the largest natural lake in North Macedonia?	66.42 %
9.	What is the largest river in North Macedonia?	66.42 %
10.	What is the highest mountain in North Macedonia?	52.56 %
11.	What is the symbol of the city of Skopje?	65.69 %
12.	Which state does North Macedonia share a border with in the east?	24.82 %
13.	What is the largest plain in the Republic of North Macedonia?	20.44 %
14.	The relief of the Republic of North Macedonia is predominantly characterized by?	40.88 %
15.	What is the resident population count in the Republic of North Macedonia?	17.52 %

According to the provided Table 5, it can be deduced that question number 5 exhibits the highest average of correct answers, amounting to 73.72%. Conversely, question number 6 demonstrates the lowest average of correct answers, also standing at 17.52%, which can also be seen in Figure 5.

The pre-test comprising 15 questions was administered to assess the existing proficiency of the pupils of the 5th-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The pre-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories for the 5th-grade pupils are detailed in Table 6

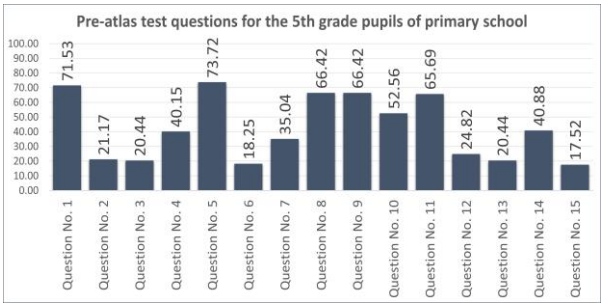

Figure 5. Pre-atlas test questions for the 5th-grade pupils, and the success percentages are represented with a chart.

Table 6. Pre-atlas test questions for the 5th-grade pupils of primary school, and the success percentages.

Category	Questions	Success percentages
A	What is the resident population count in the Republic of North Macedonia?	17.52 %
B	Which of these states does the Republic of North Macedonia not share a border with?	42.45 %
	What is the number of regions in the Republic of North Macedonia?	
	In which region of North Macedonia does the city of Bitola belong?	
	What is the number of cities in the Republic of North Macedonia?	
	What is the capital city of the Republic of North Macedonia?	
	What is the number of municipalities in the Republic of North Macedonia?	
	How many natural lakes does North Macedonia have?	
	What is the largest natural lake in North Macedonia?	
	What is the largest river in North Macedonia?	
	What is the highest mountain in North Macedonia?	
	Which state does North Macedonia share a border with in the east?	
	What is the largest plain in the Republic of North Macedonia?	
	The relief of the Republic of North Macedonia is predominantly characterized by?	
C	What is the symbol of the city of Skopje?	65.69 %

Based on the data presented in Table 6, it can be inferred that questions within Category C exhibit the highest mean accuracy, registering at 65.69%. Following this, questions categorized under Category B also demonstrate an accuracy rate of 42.45%. Conversely, Category A questions yield the lowest mean accuracy, maintaining a rate of 17.52%, which can also be seen in Figure 6.

Based on pupils' results provided in the initial tables related to the pre-atlas test, the female pupil's group of the 5th-class achieved an accuracy rate of 44.58%, whereas the male pupil's group of the 5th- class achieved an accuracy rate of 40.37%.

In this study, a comprehensive sample of 339 primary school pupils, spanning from the 3rd to the 5th-grade, encompassing ages ranging from 7 to 10 years, actively took part in a pre-atlas test designed to evaluate their general knowledge about the Atlas. It is important to highlight that the percentages presented in the subsequent table are derived from the accurate positive responses provided by the pupils. With the conclusion of the pre-atlas test for primary school pupils, the ensuing Table 7 illustrates the outcomes obtained from this evaluation.

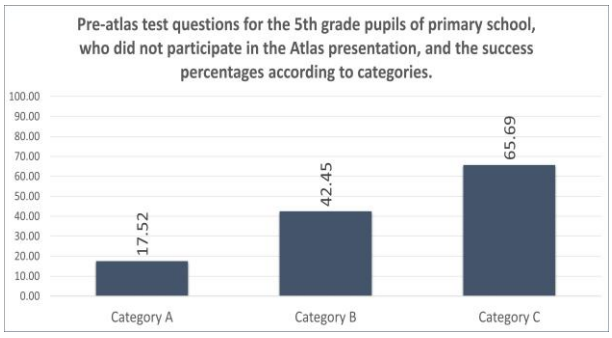

Figure 6. Pre-atlas test questions for the 5th-grade pupils according to categories, and the success percentages are represented with a chart.

According to Table 7, it can be deduced that question number 8 exhibits the highest average of correct answers, amounting to 73.49%. Conversely, question number 6 demonstrates the lowest average of correct answers, also standing at 15.79%, which can also be seen in Figure 7.

Table 7. Pre-atlas test questions for all pupils of the primary school pupils (from 3rd-grade to 5th-grade), and the success percentages.

	Questions	Success percentages
1.	Which of these states does the Republic of North Macedonia not share a border with?	59.09 %
2.	What is the number of regions in the Republic of North Macedonia?	35.68 %
3.	In which region of North Macedonia does the city of Bitola belong?	18.16 %
4.	What is the number of cities in the Republic of North Macedonia?	27.04 %
5.	What is the capital city of the Republic of North Macedonia?	67.65 %
6.	What is the number of municipalities in the Republic of North Macedonia?	15.79 %
7.	How many natural lakes does North Macedonia have?	32.81 %
8.	What is the largest natural lake in North Macedonia?	73.49 %
9.	What is the largest river in North Macedonia?	49.32 %
10.	What is the highest mountain in North Macedonia?	28.40 %
11.	What is the symbol of the city of Skopje?	59.29 %
12.	Which state does North Macedonia share a border with in the east?	23.71 %
13.	What is the largest plain in the Republic of North Macedonia?	16.85 %
14.	The relief of the Republic of North Macedonia is predominantly characterized by?	35.90 %
15.	What is the resident population count in the Republic of North Macedonia?	18.73 %

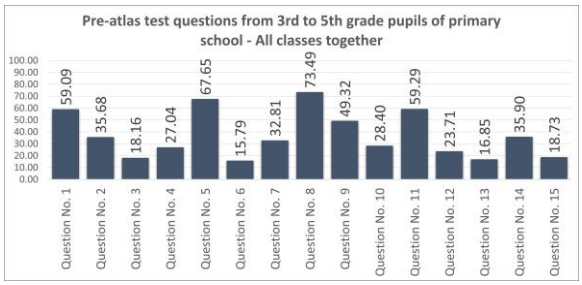

Figure 7. Pre-atlas test questions for all classes together (3rd to 5th-grade pupils), and the success percentages are represented with a chart.

A pre-test comprising 15 questions was administered to assess the existing proficiency of the pupils from the 3rd-grade to the 5th-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The pre-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories from the 3rd-grade to the 5th-grade pupils are detailed in Table 8.

Table 8. Pre-atlas test questions for all pupils of the primary school pupils (from 3rd-grade to 5th-grade), and the success percentages.

Category	Questions	Success percentages
A	What is the resident population count in the Republic of North Macedonia?	18.74 %
B	Which of these states does the Republic of North Macedonia not share a border with?	37.22 %
	What is the number of regions in the Republic of North Macedonia?	
	In which region of North Macedonia does the city of Bitola belong?	
	What is the number of cities in the Republic of North Macedonia?	
	What is the capital city of the Republic of North Macedonia?	
	What is the number of municipalities in the Republic of North Macedonia?	
	How many natural lakes does North Macedonia have?	
	What is the largest natural lake in North Macedonia?	
	What is the largest river in North Macedonia?	
	What is the highest mountain in North Macedonia?	
	Which state does North Macedonia share a border with in the east?	
	What is the largest plain in the Republic of North Macedonia?	
	The relief of the Republic of North Macedonia is predominantly characterized by?	
C	What is the symbol of the city of Skopje?	49.39 %

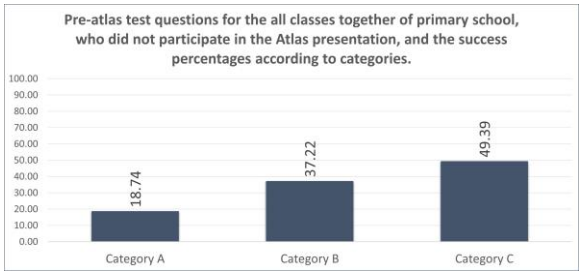

Figure 8. Pre-atlas test questions for all classes together (3rd to 5th-grade pupils), according to categories, and the success percentages are represented with a chart.

Based on the data presented in Table 8, it can be inferred that questions within Category C exhibit the highest mean accuracy, registering at 49.39%. Following this, questions categorized under Category B also demonstrate an accuracy rate of 37.22% Conversely, Category A questions yield the lowest mean accuracy, maintaining a rate of 18.74%, which can also be seen in Figure 8.

Based on the results provided in the initial tables related to the pre-atlas test, the female pupil's group represented

from the 3rd-class to the 5th-class achieved an accuracy rate of 38.54%, whereas the male pupil's group of the 5th-class achieved an accuracy rate of 38.28%.

This study involved the participation of 339 pupils enrolled in primary schools across various grade levels, including the 3rd to the 5th-grade, with an age range of 7 to 10 years. Specifically, the sample comprised 71 pupils in the third grade, 131 pupils in the fourth grade, and 137 pupils in the fifth grade, of which 160 of them are female and 179 of them are male. Following the completion of the pre-atlas test tailored for primary school pupils, and the subsequent Table 9 and Figure 9 displays the results obtained from this assessment.

Table 9. Pre-atlas test questions for all pupils, part of the primary school (from 3rd-grade to 5th-grade), and the success percentages.

Questions	Success percentages
The results of the third classes	31.27 %
The results of the fourth classes	38.78 %
The results of the fifth classes	42.34 %
---	---
The results of all classes together / Average	37.46 %

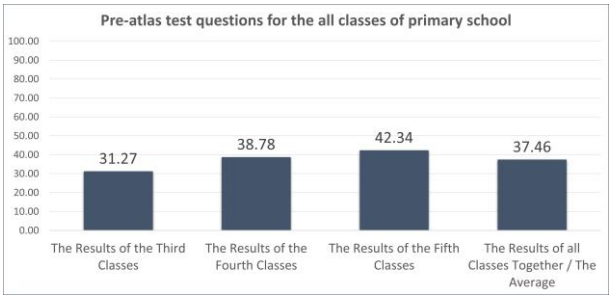

Figure 9. Pre-atlas test questions for all classes together (3rd to 5th-grade pupils), and the success percentages are represented with a chart – the average.

The pre-test comprising 15 questions was administered to assess the existing proficiency of the pupils from the 3rd-grade to the 5th-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The pre-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories from the 3rd- grade to the 5th-grade pupils are detailed in Table 10:

Based on the data presented in Table 10, it can be inferred that questions within Category C exhibit the highest mean accuracy according to all classes together, registering at 49.39%. Following this, questions categorized under Category B also demonstrate an accuracy rate of 37.22%. Conversely, Category A questions yield the lowest mean accuracy, maintaining a rate of 18.74%, which can also be seen in Figure 10.

Table 10. Pre-atlas test questions for all pupils, part of the primary school (from 3rd-grade to 5th-grade), and the success percentages according to categories.

Questions	Category	Success percentages
The results of the third classes	**A**	21.13 %
	B	30.23 %
	C	54.93 %
The results of the fourth classes	**A**	17.56 %
	B	38.99 %
	C	57.25 %
The results of the fifth classes	**A**	17.52 %
	B	42.45 %
	C	65.69 %
The results of all classes together / Average	**A**	18.74 %
	B	37.22 %
	C	49.39 %

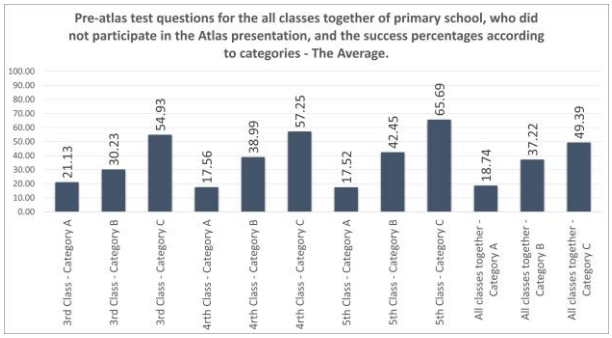

Figure 10. Pre-atlas test questions for all classes together (3rd to 5th-grade pupils), according to categories, and the success percentages are represented with a chart.

Derived from the outcomes of both the female group and male group, the overall results related to pre-atlas test are visually presented in the form of a figure or chart, as follows in Figure 11 and Figure 12.

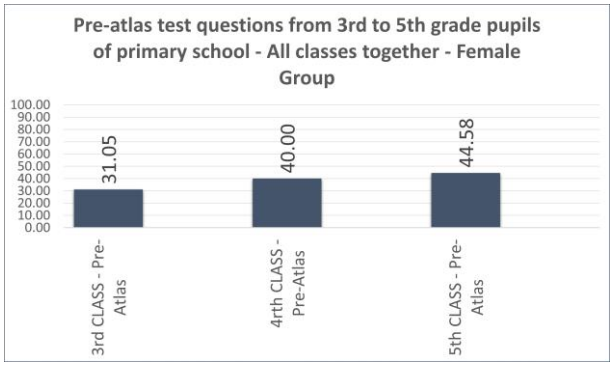

Figure 11. Pre-atlas test questions for all classes together (3rd to 5th-grade pupils) – female group, and the success percentages are represented with a chart.

3.1. Post-atlas test questions

A total of 71 primary school pupils in the 3rd-grade, who did not participate in the Atlas presentation, as part of the control group of pupils, specifically aged 7 and 8 years, were categorized and stratified into two cohorts: the female group, consisting of 35 participants, and the male group, comprising 36 participants, actively participated in the post-atlas test, which aimed to evaluate their general knowledge about the Atlas. It is crucial to highlight that the percentages presented in the subsequent table are derived from the pupils' accurate positive answers. Following the completion of the post-atlas test for primary school pupils, the results obtained from this identical test are now presented in Table 11 below:

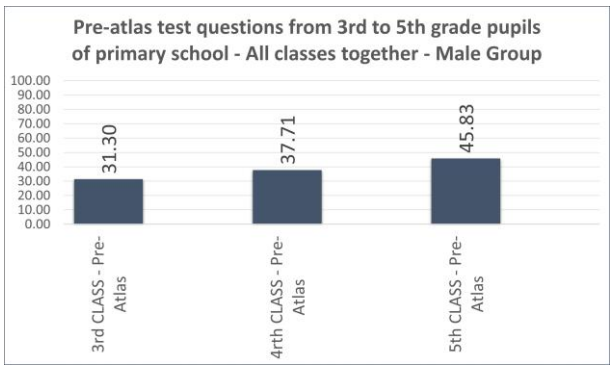

Figure 12. Pre-atlas test questions for all classes together (3rd to 5th-grade pupils) – male group, and the success percentages are represented with a chart.

Table 11. Post-atlas test questions, for the 3rd-grade pupils of primary school, who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages.

	Questions	Success percentages
1.	In which region does the skiing center "Mavrova" belong?	28.17 %
2.	How many countries borders the Republic of North Macedonia?	23.94 %
3.	In which region of North Macedonia does the city of Debar belong?	4.23 %
4.	The Museum of the Alphabet of the Albanian Language is located in the city of?	22.54 %
5.	In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?	23.94 %
6.	What is the largest ethnic group in the Republic of North Macedonia?	36.62 %
7.	Which is the most populated region in the Republic of North Macedonia?	50.70 %
8.	Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?	42.25 %
9.	Trofta fish is characteristic of the city of?	39.44 %
10.	In which city of North Macedonia is the Monument of Ilinden - Makedonium?	8.45 %
11.	Sharr's dog is characteristic for the region of?	16.90 %
12.	The old/ancient city of Stobi is located in the region of?	28.17 %
13.	Which of these elements is considered a historical element in the city of Tetova?	46.48 %
14.	In which city of the Republic of North Macedonia is rice grown?	14.09 %
15.	Matka Canyon and Mustafa Pasha Mosque are part of the city of?	15.49 %

According to Table 11, it can be deduced that question number 7 exhibits the highest average of correct answers, amounting to 50.70%. Conversely, question number 3 demonstrates the lowest average of correct answers, also standing at 4.23%, which can also be seen in Figure 13.

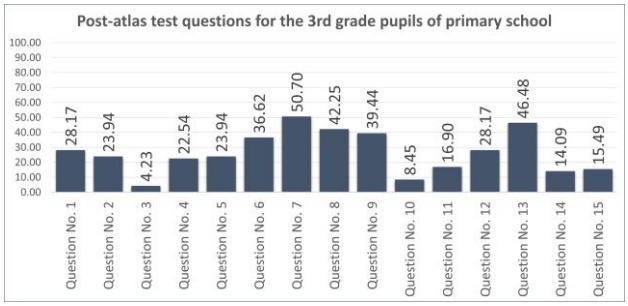

Figure 13. Post-atlas test questions for the 3rd-grade pupils, and the success percentages are represented with a chart.

The post-test comprising 15 questions was administered to assess the existing proficiency of the pupils of the 3rd-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The post-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories of the 3rd-grade pupils are detailed in Table 12:

Based on the data presented in Table 12, it can be inferred that questions within Category A exhibit the highest mean accuracy, registering at 43.19%. Following this, questions categorized under Category C also demonstrate an accuracy rate of 24.15% Conversely, Category B questions yield the lowest mean accuracy, maintaining a rate of 20.56%, which can also be seen in Figure 14.

Table 12. Post-atlas test questions, for the 3rd-grade pupils of primary school, who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages.

Category	Questions	Success percentages
A	What is the largest ethnic group in the Republic of North Macedonia? Which is the most populated region in the Republic of North Macedonia? Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?	43.19 %
B	In which region does the skiing center "Mavrova" belong? How many countries borders the Republic of North Macedonia? In which region of North Macedonia does the city of Debar belong? The Museum of the Alphabet of the Albanian Language is located in the city of? In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?	20.56 %
C	Trofta fish is characteristic of the city of? In which city of North Macedonia is the Monument of Ilinden - Makedonium? Sharr's dog is characteristic for the region of? The old/ancient city of Stobi is located in the region of? Which of these elements is considered a historical element in the city of Tetova? In which city of the Republic of North Macedonia is rice grown? Matka Canyon and Mustafa Pasha Mosque are part of the city of?	24.15 %

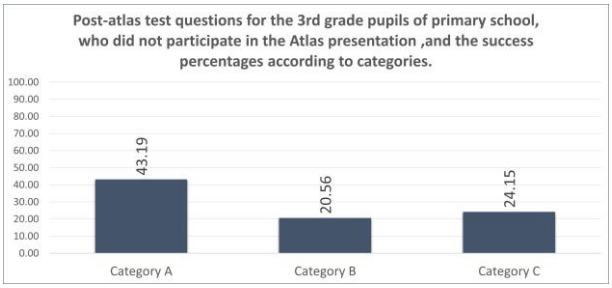

Figure 14. Post-atlas test questions for the 3rd-grade pupils according to categories as part of the control group of pupils, and the success percentages are represented with a chart.

Based on the results provided in the initial tables related to the post-atlas test, the female pupil's group of the 3rd-class achieved an accuracy rate of 25.52%, whereas the male pupil's group of the 3rd achieved an accuracy rate of 27.78%. A total of 131 primary school pupils in the 4th-grade, who did not participate in the Atlas presentation, as part of the control group of pupils, specifically aged 8 and 9 years, categorized and stratified into two cohorts: the female group, consisting of 61 participants, and the male group, comprising 70 participants, actively participated in the post-atlas test, which aimed to assess their general knowledge about the Atlas. It is essential to emphasize that the percentages presented in the subsequent table are derived from the pupils' accurate positive answers. Subsequent to the completion of the post-atlas test for primary school pupils, the results obtained from this identical test are now presented in Table 13.

According to Table 13, it can be deduced that question number 7 exhibits the highest average of correct answers, amounting to 61.07% Conversely, question number 3 demonstrates the lowest average of correct answers, also standing at 8.40%, which can also be seen in Figure 15.

Table 13. Post-atlas test questions, for the 4th-grade pupils of primary school, who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages.

	Questions	Success percentages
1.	In which region does the skiing center "Mavrova" belong?	32.82 %
2.	How many countries borders the Republic of North Macedonia?	35.88 %
3.	In which region of North Macedonia does the city of Debar belong?	8.40 %
4.	The Museum of the Alphabet of the Albanian Language is located in the city of?	49.62 %
5.	In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?	19.85 %
6.	What is the largest ethnic group in the Republic of North Macedonia?	44.28 %
7.	Which is the most populated region in the Republic of North Macedonia?	61.07 %
8.	Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?	38.08 %
9.	Trofta fish is characteristic of the city of?	43.51 %
10.	In which city of North Macedonia is the Monument of Ilinden - Makedonium?	21.37 %
11.	Sharr's dog is characteristic for the region of?	16.03 %
12.	The old/ancient city of Stobi is located in the region of?	28.24 %
13.	Which of these elements is considered a historical element in the city of Tetova?	59.54 %
14.	In which city of the Republic of North Macedonia is rice grown?	25.19 %
15.	Matka Canyon and Mustafa Pasha Mosque are part of the city of?	23.66 %

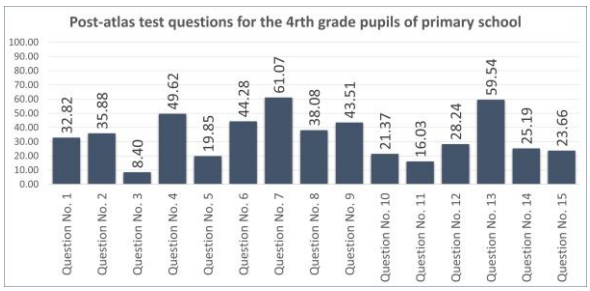

Figure 15. Post-atlas test questions for the 4th-grade pupils, and the success percentages are represented with a chart.

The post-test comprising 15 questions was administered to assess the existing proficiency of the pupils of the 4th-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The post-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories of the 4th-grade pupils are detailed in Table 14.

Table 14. Post-atlas test questions, for the 4th-grade pupils of primary school, who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages.

Category	Questions	Success percentages
A	What is the largest ethnic group in the Republic of North Macedonia? Which is the most populated region in the Republic of North Macedonia? Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?	47.84 %
B	In which region does the skiing center "Mavrova" belong? How many countries borders the Republic of North Macedonia? In which region of North Macedonia does the city of Debar belong? The Museum of the Alphabet of the Albanian Language is located in the city of? In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?	29.31 %
C	Trofta fish is characteristic of the city of? In which city of North Macedonia is the Monument of Ilinden - Makedonium? Sharr's dog is characteristic for the region of? The old/ancient city of Stobi is located in the region of? Which of these elements is considered a historical element in the city of Tetova? In which city of the Republic of North Macedonia is rice grown? Matka Canyon and Mustafa Pasha Mosque are part of the city of?	31.08 %

Based on the data presented in Table 14, it can be inferred that questions within Category A exhibit the highest mean accuracy, registering at 47.84%. Following this, questions categorized under Category C also demonstrate an accuracy rate of 31.08%. Conversely, Category B questions yield the lowest mean accuracy, maintaining a rate of 29.31%, which can also be seen in Figure 16.

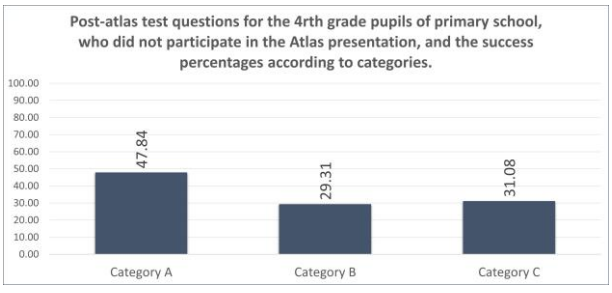

Figure 16. Post-atlas test questions for the 4th-grade pupils according to categories, and the success percentages are represented with a chart.

Based on the results provided in the initial tables related to the post-atlas test, the female pupil's group of the 4th-class achieved an accuracy rate of 32.79%, whereas the male pupil's group of the 4th achieved an accuracy rate of 34.76%.

A comprehensive total of 137 primary school pupils, who did not participate in the Atlas presentation, as part of the control group of pupils, specifically belonging to the 5th-grade and aged between 9 and 10 years, were categorized and stratified into two cohorts: the female group, consisting of 64 participants, and the male group, comprising 73 participants, actively engaged in the post-atlas test, which aimed to evaluate their general knowledge concerning the Atlas. It is imperative to highlight that the percentages displayed in the subsequent table are derived solely from the pupils' correct positive responses. Following the successful completion of the post-atlas test for primary school pupils, the obtained results from this identical assessment are now meticulously presented in Table 15.

According to Table 15, it can be deduced that question number 13 exhibits the highest average of correct answers, amounting to 76.64%. Conversely, question number 3 and 12 demonstrates the lowest average of correct answers, also standing at 19.71%, which can also be seen in Figure 17.

Table 15. Post-atlas test questions for the 5th-grade pupils of primary school, who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages.

	Questions	Success percentages
1.	In which region does the skiing center "Mavrova" belong?	31.39 %
2.	How many countries borders the Republic of North Macedonia?	59.85 %
3.	In which region of North Macedonia does the city of Debar belong?	19.71 %
4.	The Museum of the Alphabet of the Albanian Language is located in the city of?	67.88 %
5.	In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?	21.17 %
6.	What is the largest ethnic group in the Republic of North Macedonia?	59.12 %
7.	Which is the most populated region in the Republic of North Macedonia?	69.34 %
8.	Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?	51.10 %
9.	Trofta fish is characteristic of the city of?	53.28 %
10.	In which city of North Macedonia is the Monument of Ilinden - Makedonium?	29.93 %
11.	Sharr's dog is characteristic for the region of?	32.12 %
12.	The old/ancient city of Stobi is located in the region of?	19.71 %
13.	Which of these elements is considered a historical element in the city of Tetova?	76.64 %
14.	In which city of the Republic of North Macedonia is rice grown?	51.10 %
15.	Matka Canyon and Mustafa Pasha Mosque are part of the city of?	30.66 %

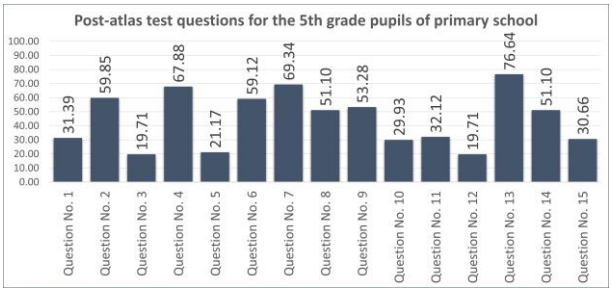

Figure 17. Post-atlas test questions for the 5th-grade pupils, and the success percentages are represented with a chart.

The post-test comprising 15 questions was administered to assess the existing proficiency of the pupils of the 5th-grade. The test questions were formulated and categorized as follows:

A. Map and Atlas concepts (Category A)

B. Directions, geographical regions, and neighboring areas (Category B)

C. Tourism and Economy in North Macedonia (Category C).

The post-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories of the 5th-grade pupils are detailed in Table 16. Based on the data presented in Table 16, it can be inferred that questions within Category A exhibit the highest mean accuracy, registering at 59.85%. Following this, questions categorized under Category C also demonstrate an accuracy rate of 41.92%. Conversely, Category B questions yield the lowest mean accuracy, maintaining a rate of 40.00%, which can also be seen in Figure 18.

Table 16. Post-atlas test questions for the 5th-grade pupils of primary school, who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages according to categories.

Category	Questions	Success percentages
A	What is the largest ethnic group in the Republic of North Macedonia? Which is the most populated region in the Republic of North Macedonia? Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?	59.85 %
B	In which region does the skiing center "Mavrova" belong? How many countries borders the Republic of North Macedonia? In which region of North Macedonia does the city of Debar belong? The Museum of the Alphabet of the Albanian Language is located in the city of? In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?	40.00 %
C	Trofta fish is characteristic of the city of? In which city of North Macedonia is the Monument of Ilinden - Makedonium? Sharr's dog is characteristic for the region of? The old/ancient city of Stobi is located in the region of? Which of these elements is considered a historical element in the city of Tetova? In which city of the Republic of North Macedonia is rice grown? Matka Canyon and Mustafa Pasha Mosque are part of the city of?	41.92 %

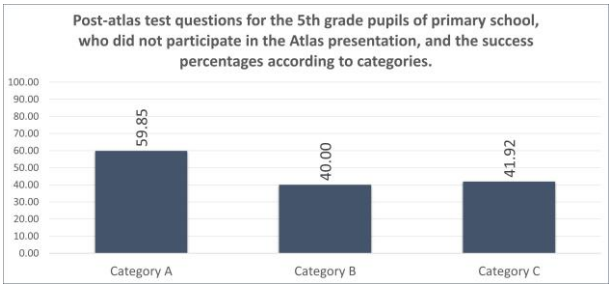

Figure 18. Post-atlas test questions for the 5th-grade pupils according to categories, and the success percentages are represented with a chart.

Based on the results provided in the initial tables related to the post-atlas test, the female pupil's group of the 5th-class achieved an accuracy rate of 40.37%, whereas the male pupil's group of the 5th achieved an accuracy rate of 44.02%.

A comprehensive cohort of 339 primary school pupils, who did not participate in the Atlas presentation, as part of the control group of pupils, spanning across grades 3 to 5, categorized and stratified into two cohorts: the female group, consisting of 160 participants, and the male group, comprising 179 participants. encompassing pupils aged between 6 and 10 years, actively partook in the post-atlas test, which was designed to assess their general knowledge about the Atlas. It is crucial to emphasize that the percentages provided in the subsequent table are contingent upon the pupils' accurate positive responses. As the post-atlas test for primary school pupils has been successfully concluded, the ensuing Table 17 showcases the outcomes obtained from the identical assessment.

Table 17. Post-atlas test questions for all pupils of primary school (from 3rd-grade to 5th-grade), who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages.

	Questions	Success percentages
1.	In which region does the skiing center "Mavrova" belong?	30.79 %
2.	How many countries borders the Republic of North Macedonia?	39.89 %
3.	In which region of North Macedonia does the city of Debar belong?	10.78 %
4.	The Museum of the Alphabet of the Albanian Language is located in the city of?	46.68 %
5.	In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?	21.65 %
6.	What is the largest ethnic group in the Republic of North Macedonia?	46.67 %
7.	Which is the most populated region in the Republic of North Macedonia?	60.37 %
8.	Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?	43.84 %
9.	Trofta fish is characteristic of the city of?	45.41 %
10.	In which city of North Macedonia is the Monument of Ilinden - Makedonium?	19.92 %
11.	Sharr's dog is characteristic for the region of?	21.68 %
12.	The old/ancient city of Stobi is located in the region of?	25.37 %
13.	Which of these elements is considered a historical element in the city of Tetova?	60.89 %
14.	In which city of the Republic of North Macedonia is rice grown?	30.12 %
15.	Matka Canyon and Mustafa Pasha Mosque are part of the city of?	23.27 %

According to Table 17, it can be deduced that question number 13 exhibits the highest average of correct answers, amounting to 60.89%. Conversely, question number 3 demonstrates the lowest average of correct answers, also standing at 10.78%, which can also be seen in Figure 19.

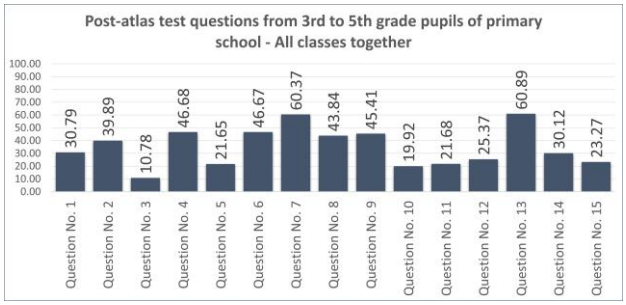

Figure 19. Post-atlas test questions for all classes together (3rd to 5th-grade pupils), and the success percentages are represented with a chart.

The post-test comprising 15 questions was administered to assess the existing proficiency of the pupils from the 3rd-grade to the 5th-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The post-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories from the 3rd- grade to the 5th-grade pupils are detailed in Table 18:

Based on the data presented in Table 18, it can be inferred that questions within Category A exhibit the highest mean accuracy, registering at 50.29%. Following this, questions categorized under Category C also demonstrate an accuracy rate of 32.38%. Conversely, Category B questions yield the lowest mean accuracy, maintaining a rate of 29.96%, which can also be seen in Figure 20.

Table 18. Post-atlas test questions for all pupils of primary school (from 3rd-grade to 5th-grade), who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages according to categories.

Category	Questions	Success percentages
A	What is the largest ethnic group in the Republic of North Macedonia?	50.29 %
	Which is the most populated region in the Republic of North Macedonia?	
	Based on the maps and the atlas, the state border of the Republic of North Macedonia is represented by?	
B	In which region does the skiing center "Mavrova" belong?	29.96 %
	How many countries borders the Republic of North Macedonia?	
	In which region of North Macedonia does the city of Debar belong?	
	The Museum of the Alphabet of the Albanian Language is located in the city of?	
	In which region is the highest mountain of the Republic of North Macedonia, Mount Korabi?	
C	Trofta fish is characteristic of the city of?	32.38 %
	In which city of North Macedonia is the Monument of Ilinden - Makedonium?	
	Sharr's dog is characteristic for the region of?	
	The old/ancient city of Stobi is located in the region of?	
	Which of these elements is considered a historical element in the city of Tetova?	
	In which city of the Republic of North Macedonia is rice grown?	
	Matka Canyon and Mustafa Pasha Mosque are part of the city of?	

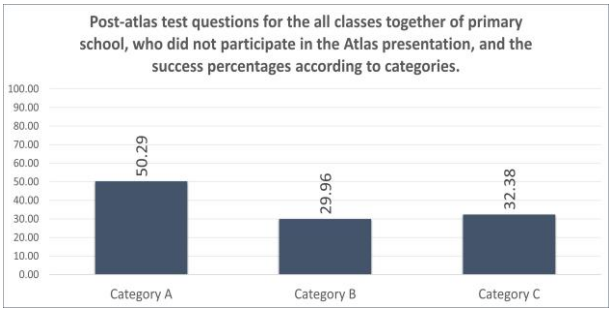

Figure 20. Post-atlas test questions for all classes together (3rd to 5th-grade pupils), according to categories, and the success percentages are represented with a chart.

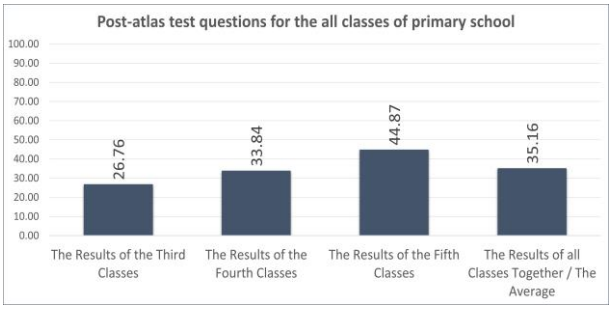

Figure 21. Post-atlas test questions for all classes together (3rd to 5th-grade pupils), and the success percentages are represented with a chart – the average.

Based on the results provided in the initial tables related to the post-atlas test, the female pupils group represented from the 3rd-class to the 5th- class achieved an accuracy rate of 32.89%, whereas the male pupils group of the 5th-class achieved an accuracy rate of 35.52%. A comprehensive cohort of 339 pupils from primary schools, who did not participate in the Atlas presentation, as part of the control group of pupils, ranging from the 3rd to the 5th-grade and aged between 6 and 10 years, categorized and stratified into two cohorts: the female group, consisting of 160 participants, and the male group, comprising 179 participants, actively participated in the post-atlas test. Among them, 71 pupils in the third grade, 131 pupils in the fourth grade, and 137 pupils in the fifth grade. With the completion of the post-atlas test tailored for primary school pupils, the subsequent Table 19 exhibits the results obtained from the aforementioned assessment, as follows:

Table 19. Post-atlas test questions for all pupils of primary school (from 3rd-grade to 5th-grade), who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages.

Questions	Success percentages
The results of the third classes	26.76 %
The results of the fourth classes	33.84 %
The results of the fifth classes	44.87 %
---	---
The results of all classes together / Average	35.16 %

The post-test comprising 15 questions was administered to assess the existing proficiency of the pupils from the 3rd-grade to the 5th-grade. The test questions were formulated and categorized as follows:

- **A.** Map and Atlas concepts (Category A)
- **B.** Directions, geographical regions, and neighboring areas (Category B)
- **C.** Tourism and Economy in North Macedonia (Category C).

The post-atlas test also consisted of 15 questions, aligned with categories A, B, and C. The outcomes corresponding to these categories from the 3rd- grade to the 5th-grade pupils are detailed in Table 20:

Table 20. Post-atlas test questions for all pupils of primary school (from 3rd-grade to 5th-grade), who did not participate in the Atlas presentation as part of the control group of pupils, and the success percentages according to categories.

Questions	Category	Success percentages
The results of the third classes	**A**	43.19 %
	B	20.56 %
	C	24.15 %
The results of the fourth classes	**A**	47.84 %
	B	29.31 %
	C	31.08 %
The results of the fifth classes	**A**	59.85 %
	B	40.00 %
	C	41.92 %
The results of all classes together / Average	**A**	50.29 %
	B	29.96 %
	C	32.38 %

Based on the data presented in Table 20, it can be inferred that questions within Category A exhibit the highest mean accuracy for all classes together, registering at 50.29%. Following this, questions categorized under Category C also demonstrate an accuracy rate of 32.38%. Conversely, Category B questions yield the lowest mean accuracy, maintaining a rate of 29.96%, which can also be seen in Figure 22.

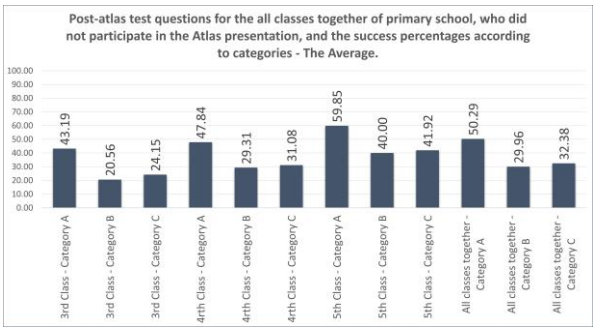

Figure 22. Post-atlas test questions for all classes together (3rd to 5th-grade pupils), according to categories, and the success percentages are represented with a chart.

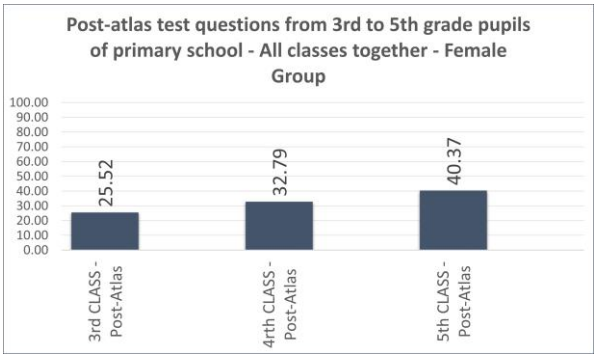

Figure 23. Post-atlas test questions for all classes together (3rd to 5th-grade pupils) – female group, and the success percentages are represented with a chart.

Derived from the outcomes of both the female group and male group, the overall results related to post-atlas test are visually presented in the form of a figure or chart, as follows in Figure 23 and Figure 24.

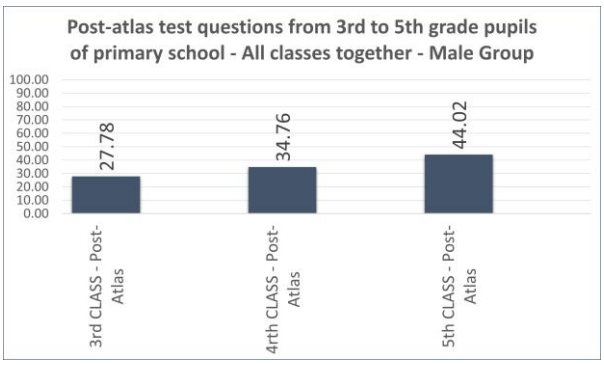

Figure 24. Post-atlas test questions for all classes together (3rd to 5th-grade pupils) – male group, and the success percentages are represented with a chart.

In this study, we employed t-tests, calculated using Microsoft Excel, to rigorously examine the significance of observed differences between distinct groups within our sample, the experimental group of pupils and the control group of pupils. 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 tables and descriptive texts related to the tables are presented as follows:

Table 21. Findings regarding Pre-Atlas and Post-Atlas test results questions for the 3rd-grade pupils of primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**71**	31.28	18.44	2.15	0.40
Post Atlas	**71**	26.76	13.95		

In accordance with the tabular data of Table 21, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.40, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 22. Findings regarding Pre-Atlas and Post-Atlas test results questions for the 4th-grade pupils of primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**131**	38.78	22.46	2.15	0.53
Post Atlas	**131**	33.84	15.59		

In accordance with the tabular data of Table 22, discernible dissimilarity was not observed between the

experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.53, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 23. Findings regarding Pre-Atlas and Post-Atlas test results questions for the 5th-grade pupils of primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**137**	42.34	21.74	2.15	0.77
Post Atlas	**137**	44.87	19.48		

In accordance with the tabular data of Table 23, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.77, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 24. Findings regarding Pre-Atlas and Post-Atlas test results questions of categories, for the 3rd-grade pupils of primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**71**	33.43	17.49	4.30	0.73
Post Atlas	**71**	29.30	12.16		

In accordance with the tabular data of Table 24, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.73, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 25. Findings regarding Pre-Atlas and Post-Atlas test results questions of categories, for the 4th-grade pupils of primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**131**	37.93	19.87	4.30	0.92
Post Atlas	**131**	36.08	10.22		

In accordance with the tabular data of Table 25, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.92, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 26. Findings regarding Pre-Atlas and Post-Atlas test results questions of categories, for the 5th-grade pupils of primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**137**	41.89	24.09	4.30	0.81
Post Atlas	**137**	47.26	10.95		

In accordance with the tabular data of Table 26, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.81, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 27. Findings regarding Pre-Atlas and Post-Atlas test results questions, for all classes together of the primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**339**	37.46	19.49	2.15	0.74
Post Atlas	**339**	35.16	15.21		

In accordance with the tabular data of Table 27, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.74, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 28. Findings regarding Pre-Atlas and Post-Atlas test results questions of categories, for all classes together of the primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**339**	35.12	15.43	4.30	0.89
Post Atlas	**339**	37.54	11.11		

In accordance with the tabular data of Table 28, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.89, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 29. Findings regarding Pre-Atlas and Post-Atlas test results questions for averages of all classes together of the primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**339**	37.46	5.65	4.30	0.44
Post Atlas	**339**	35.16	9.12		

In accordance with the tabular data of Table 29, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.44, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

Table 30. Findings regarding Pre-Atlas and Post-Atlas test results questions for averages of categories of all classes together of the primary school.

Groups	Number of Pupils (N)	Arithmetic Average(X) (out of 100)	Standard Deviation (SD)	t value	P value
Pre Atlas	**339**	35.12	15.43	4.30	0.89
Post Atlas	**339**	37.54	11.11		

In accordance with the tabular data of Table 30, discernible dissimilarity was not observed between the experimental and control cohorts concerning mean pre-test and post-test scores, as indicated by a p-value of 0.89, which exceeds the conventional threshold of statistical significance ($p > 0.05$).

4. Conclusions

In this comprehensive study, both pre-atlas and post-atlas tests were conducted to assess the general knowledge of primary school pupils in the 3rd to 5th-grades regarding the Republic of North Macedonia. The participants, categorized by grade and gender, underwent evaluations encompassing map and atlas concepts, directions, geographical regions, neighboring areas, tourism, and economy in North Macedonia.

The results of the pre-atlas unveiled varying proficiency levels across different grades and categories. Notably, the largest natural lake question (Question 8) exhibited the highest average correct answers, while the question regarding the number of municipalities (Question 6) showed the lowest average.

The results of the post-atlas unveiled varying proficiency levels across different grades and categories too. Notably, the historical elements of the city of Tetovo question (Question 13) exhibited the highest average correct answers, while the question regarding the region where the city of Debar (Dibra) belongs (Question 3) showed the lowest average.

When analyzed by grade, in the pre-atlas test 5th-grade pupils achieved the highest mean accuracy, excelling in Category C questions. In contrast, 3rd-grade pupils had the lowest mean accuracy, especially in Category A. Conversely, in the post-atlas test 5th-grade pupils achieved the highest mean accuracy, excelling in Category A questions. In contrast, 3rd-grade pupils had the lowest mean accuracy, especially in Category B.

Regarding gender differences, female pupils generally outperformed males across all grades, albeit with marginal disparities, indicating a relatively uniform knowledge level among both genders.

In the comprehensive analysis of Pre-Atlas and Post-Atlas test results across various grade levels within the primary school setting, the application of t-tests using Microsoft Excel revealed no discernible dissimilarities between the experimental and control groups. Employing a rigorous statistical approach, the calculated p-values consistently exceeded the conventional threshold of statistical significance ($p > 0.05$). For instance, in examining the 3rd, 4th, and 5th-grade pupils, as well as the collective data for all classes, the p-values ranged from 0.40 to 0.92, indicating a lack of statistically significant differences in mean pre-test and post-test scores. These results underscore the robustness and reliability of the findings, affirming the effectiveness of the experimental intervention. The absence of statistically significant variations enhances the validity of our conclusions, reinforcing the notion that the Atlas presentation did not yield notable impacts on the academic performance of the participating pupils. Considering the calculated p-value surpasses the significance threshold of 0.05, as determined by the t-test analysis, it can be inferred that the observed outcomes regarding the knowledge levels in both the pre-atlas test and post-atlas test, demonstrate equivalence in the context of the conducted testing. Consequently, according to the results, no statistically significant distinctions are evident between the two groups of tests.

While the study highlighted notable proficiency within normal sequences in map and atlas concepts, there is

room for improvement and development, particularly in geographical regions, directions, and neighboring areas.

In summary, this study provides valuable insights into the geographic knowledge and map reading of primary school pupils in North Macedonia. The results emphasize the need for targeted educational interventions, especially in map and atlas comprehension, to enhance a comprehensive understanding of the country's geographical features. The utilization of maps, whether integrated into textbooks or presented in standalone formats, should be given increased emphasis in the early stages of primary education. Moreover, the incorporation of atlases is particularly essential within this educational phase, contributing significantly to the advancement and enhancement of pupils' capabilities and proficiency, particularly in the cultivation of their geographical skills. The findings contribute to the discourse on geography education, stressing the importance of tailored approaches to address proficiency variations among different grade levels and genders. Future research should explore effective teaching strategies and interventions to further enhance geographic literacy among primary school pupils, aiming to contribute to a well-informed and geographically literate younger generation.

Declaration of Ethical Standards

The authors declare that they comply with all ethical standards.

Credit Authorship Contribution Statement

Author-1: Conceptualization, investigation, methodology, data collecting, data curation, analysis, visualization, and writing – original draft preparation.

Author-2: Conceptualization, data curation, supervision, writing – original draft preparation and writing – review and editing.

Declaration of Competing Interest

The authors have no conflicts of interest to declare regarding the content of this article.

Data Availability Statement

All data generated or analyzed during this study are included in this published article.

Acknowledgement

The Atlas project and this work has been supported by Necmettin Erbakan University Scientific Research Projects Coordination Unit under project number 23YL19002. As authors, we extend our sincere gratitude to the Necmettin Erbakan University and Necmettin Erbakan University Scientific Research Projects Coordination Unit for its unwavering support throughout this study.

5. References

Bandrova, T., and Deleva, A., 1998. Contemporary cartography for children in Bulgaria. In *The Join Seminar "Maps for Special Users", Wroclaw, Poland*, 59-78.

Bandrova, T., and Deleva, A., 1999. A Cartographic Atlas Created for and with the Help of Children. In *Proceedings of the Joint Seminar on Discovering basic Concepts, Canada*, 45-49.

Blades, M. and Spencer, C., 1987. The use of maps by 4–6-year-old children in a large-scale maze. *British Journal of Developmental Psychology*, ***5*(1)**, 19-24. https://doi.org/10.1111/j.2044-835X.1987.tb01037.x

Bugdayci, I., and Selvi, H. Z., 2017. Teaching map concepts in Social Science Education; an evaluation with undergraduate students. In *IOP Conference Series: Earth and Environmental Science* **95(3)**, 032002. IOP Publishing. https://doi.org/10.1088/1755-1315/95/3/032002

Bugdayci, I., and Selvi, H. Z., 2021. Do Maps Contribute to Pupils' Learning Skills in Primary Schools?. *The Cartographic Journal*, ***58*(2)**, 135-149. https://doi.org/10.1080/00087041.2020.1760625

Catling, S., 2005. Developing children's understanding and use of maps. *Primary social studies: Exploring pedagogy and content*, 220-250.

DiBiase, D., Corbin, T., Fox, T., Francica, J., Green, K., Jackson, J., ... and Van Sickle, J., 2010. The new geospatial technology competency model: Bringing workforce needs into focus. *Urisa Journal,* **22(2)**, 55.

Golledge, R. G., 2002. The nature of geographic knowledge. Annals of the Association of American geographers, **92(1)**, 1-14. https://doi.org/10.1111/1467-8306.00276

Gattis, M., 2003. *Spatial schemas and abstract thought*. MIT press.

Gökçe, N., 2015. Social studies in improving students' map skills: Teachers' opinions. https://doi.org/10.12738/estp.2015.5.0071

Hanus, M., and Havelková, L., 2019. Teachers' concepts of map-skill development. Journal of geography, **118(3)**, 101-116. https://doi.org/10.1080/00221341.2018.1528294

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

Harte, J. P., & Dunbar, C., 1994. Skills in geography. Cambridge: Cambridge University Press.

Konecny, M., 2011. Cartography: challenges and potential in the virtual geographic environments era. *Annals of GIS*, ***17*(3)**, 135-146. https://doi.org/10.1080/19475683.2011.602027

MacEachren, A. M., 1992. Application of environmental learning theory to spatial knowledge acquisition from maps. *Annals of the Association of American Geographers*, ***82*(2)**, 245-274. https://doi.org/10.1111/j.1467-8306.1992.tb01907.x

Mitchell, L. S., 1991. Young geographers: How they explore the world and how they map the world.

National Research Council, 2006. Committee on the Support for Thinking Spatially: The Incorporation of Geographic Information Science Across the K-12 Curriculum, Committee on Geography. *Learning to Think Spatially* Washington, DC: The National Academies Press. https://doi.org/10.17226/11019.

Nazarenko, T., Topuzov, O., Chasnikova, O., & Dubrovina, I., 2021. Role of geography teacher in forming the pupils' cartographic competence. *Prace i Studia Geograficzne*, ***66*(2)**, 43-53. https://doi.org/10.48128/pisg/2021-66.2-03

Robertson, M., and Gerber, R., 2000. *The child's world: Triggers for learning*. Aust Council for Ed Research.

Solem, M., Cheung, I., and Schlemper, M. B., 2008. Skills in professional geography: An assessment of workforce needs and expectations. *The Professional Geographer*, ***60*(3)**, 356-373. https://doi.org/10.1080/00330120802013620

Solem, M., 2016. Geography Education, Workforce Trends, Twenty-First-Century Skills, and Geographical Capabilities. *International Encyclopedia of Geography: People, the Earth, Environment and Technology: People, the Earth, Environment and Technology*, 1-9. https://doi.org/10.1002/9781118786352.wbieg0413

Schulze, U., Kanwischer, D., and Reudenbach, C., 2011. Competence dimensions in a Bologna-oriented GIS education. *Learning with GI*, 108-117.

van Dijk, H., van der Schee, J., Trimp, H., and van der Zijpp, T., 1994. Map skills and geographical knowledge. *International Research in Geographical & Environmental Education*, ***3*(1)**, 68-80. https://doi.org/10.1080/10382046.1994.9964928