




Compiling and designing maps for primary school pupils based on children's cognitive development: A case study of North Macedonia

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ABSTRACT

Cartography, serving as a medium of interpretation and visualization, assumes a vital role as a mechanism for proficient communication. Its prevalent utilization is notably evident within the educational sphere, predominantly in primary educational institutions such as schools. The visual portrayal facilitated by maps enables young learners to assimilate knowledge and cultivate proficiencies related to their immediate surroundings and spatial cognition. The creation and formulation of such maps demand meticulous scrutiny and contemplation of a myriad of factors that wield influence over children, encompassing facets pertinent to their cognitive maturation and development. Within the context of this research, a comprehensive set of 16 maps were curated and devised. Among these, 8 maps constitute the primary category, encompassing the political map delineating municipalities, the administrative map showcasing cities, the regions map, the physical geographical map, the tourism and economy map, the agriculture map, the farming map, and the climate map. The remaining 8 maps belong and focus on tourism and economy, with particular emphasis placed on each of the 8 regions comprising the Republic of North Macedonia. These maps were carried out as part of the realization of the "Atlas of North Macedonia for primary school pupils" project. This atlas has been compiled and designed for pupils aged 6 to 10.

1. Introduction

Maps serve as visual depictions (Robertson & Gerber, 2000), play a pivotal role in various aspects of our daily existence (Holland, 2005), and enjoy widespread popularity due to their inherent capacity to evoke a strong visual impact (Bugdayci & Selvi, 2021). Maps shape a child's perception (Myridis et al., 2007), and they serve as a conduit for transmitting knowledge, offering a depiction of the familiar reality that distinguishes it from the perceptible reality we observe, and about the observations, findings, and discoveries made by others (Whitefield, 1997; Holland, 2005).

To ensure seamless usability of maps in education and throughout life stages, fostering their development and promotion becomes imperative for effective communication during a child's initial encounter with their surroundings (Myridis et al., 2007; Bugdayci & Selvi, 2021). The current cohort of children represents the forthcoming generation of individuals who will actively engage in utilizing and generating maps (Anderson & Vasconcellos, 1995). Children in their early stages of education represent a pivotal user group with utmost significance in the realm of map utilization (Bugdayci & Selvi, 2021). Maps are regarded as

indispensable instruments of communication within the educational realm (Myridis et al., 2007), encompassing various activities associated with the arrangement or strategizing of intricate entities (Erwin, 2011). The map assumes a crucial role as a significant communication instrument, serving as visual depictions equipping us with the means to explore and comprehend spatial relationships (Robertson & Gerber, 2000; Myridis et al., 2007).

Fostering a child's curiosity in map reading and engagement can have numerous benefits. By involving children in simple map activities, they can develop spatial awareness and an understanding of their environment. Exploring children's comprehension of spatial relationships can be effectively examined through the lens of map understanding (Peter et al., 2010). Encouraging children to create their own maps and explore different types of maps enhances their map literacy.

Developing assistive technologies tailored for the needs of children, including maps, poses significant challenges (Brule et al., 2016). The advancement in mapping targeted for children, as well as their active involvement in the mapping process, can only be attained through comprehensive engagement across various tiers, encompassing national, international, and

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grassroots levels (Anderson & Vasconcellos, 1995). The utilization of Geographical Information System (GIS) software and generic drawing software has witnessed a notable surge in generating maps through digital location data and employing computer-aided design techniques. These advanced technologies have gradually permeated primary school settings and are actively advocated by educational institutions (Ordnance Survey, 2002; ESRI, 2003).

Cognitive theories are centered around understanding the transformations that occur in our mental processes or cognitions as we grow and develop. As described by Jean Piaget, these theories emphasize the interaction between a child and their environment (Piaget, 1929). Piaget's cognitive development theory elucidates the process by which a child actively constructs a mental representation of the world. Piaget's work portrayed the developing child as an active participant in a social realm filled with contextualized meanings. His contributions have established him as a highly influential cognitive theorist within the field of child development (Piaget, 2000). A multitude of studies have been conducted, drawing significant inspiration from Jean Piaget's theory of cognitive development.

Scholarly investigations have revealed disparities in map comprehension between children and adults (Bartz, 1965; Sorrell, 1978; Gerber 1984). The cognitive development of young children involves the gradual assimilation of spatial concepts and the ability to reason about spatial location (Uttal & Sheehan, 2014). The accurate assessment of cognitive map knowledge carries significant implications for various domains, including urban planning, education, and navigational assistance (Kitchin & Jacobson, 1997). A significant developmental implication arising from our perspective is that the acquisition of spatial cognition involves the process of learning to perceive the world through the mediated lens of maps (Liben & Downs, 1989; Liben & Downs, 1991; Liben & Downs, 1993; Liben et al., 2002; Uttal, 2000; Uttal, 2005). Lynch's (1960) comprehensive investigation delved into the intricacies of individuals' cognitive maps pertaining to their urban environments. Subsequently, substantial scholarly efforts have been dedicated to exploring the progression of these cognitive maps in both children and adults (Downs & Stea, 1977; Hardwick et al., 1976; Herman & Siegel, 1978).

Additionally, utilizing maps before trips and locating places on a globe or world map can stimulate geographical knowledge. Educators are required to support pupils and students in rendering their cognitive processes explicit, aiding them in refining and structuring their reasoning based on established norms and criteria (Okada & Buckingham, 2008). Educators must devise pedagogical approaches to foster an environment conducive to exploratory discourse, wherein children possess the ability to substantiate their choices and engage in respectful inquiry of others' decisions (Owen, 2005). Embracing these map-related experiences from an early age can empower children with valuable life skills and a deeper understanding of the world around them.

Blaut (1991, 1997) asserted that the aptitude for comprehending environmental depictions, such as aerial

photographs, is an inherent and untrained capability in young children. This assertion was supported by empirical investigations, including the notable work of Stea & Blaut (1973). Following the instructional intervention, there was a noticeable enhancement in the mapping proficiencies of the students (Klonari, 2012). These findings indicate that both cohorts exhibit dissimilar approaches to perceiving maps and interpreting data, as distinct from adult perspectives. Consequently, these purported dissimilarities have prompted numerous publishers and cartographers to develop maps explicitly designed for children, diverging from those intended for adult users (Bartz, 1965; Sorrell, 1978; Gerber, 1984).

Therefore, akin to other symbolic systems such as spoken and written language, maps serve as cultural tools that facilitate the acquisition of knowledge and the expansion of human cognition by enabling us to learn about the world from others (Olson, 1994). In this regard, we contend that the ability to perceive and engage with the world through the mediated perspective of maps plays a crucial role in the development of spatial cognition. This process is facilitated by the use of symbolic representations, such as scale models. Through interactions with these models, children acquire a deeper understanding of spatial relationships and develop cognitive skills related to spatial thinking. This cognitive development in the realm of spatial location is an integral aspect of children's overall cognitive growth and contributes to their broader cognitive abilities (Uttal & Sheehan, 2014).

The examination of color usage in cartographic representation has been a subject of extensive inquiry in the field of cartographic research, constituting one of the most scrutinized facets of map design. This area of study has received significant attention from scholars throughout history, with notable contributions from researchers such as Robinson (1952), Jenks & Knos (1961), Crawford (1971), Kimerling (1980), Olson (1981), Imhof (1982), MacEachren (1995), Dent (1999), and Brewer et al. (2003). Brewer has made substantial contributions to the field of color research, with an extensive repertoire of scholarly work that spans several publications. These include Brewer (1989), Brewer (1992), Brewer (1994), Brewer (1996), Brewer (1997a), Brewer (1997b), MacEachren et al., (1998), Brewer (2003), and Brewer et al., (2003). Brewer's research encompasses a wide array of topics, such as the application of spectral color schemes, guidelines for utilizing diverging color schemes, the impact of simultaneous contrast on maps, color selection strategies to assist individuals with color impairment, and a tool for selecting suitable colors for cartographic purposes.

Within the scope of this study, the process of compiling and designing maps was undertaken as an integral component of the atlas project tailored for primary school pupils in the Republic of North Macedonia. Prior to the compilation and design of the maps, an extensive examination was conducted on social studies textbooks utilized in the second, third, fourth, and fifth grades. Additionally, the two atlases currently employed within the educational system were included in the review and evaluation process. By examining and

analyzing the existing preliminary atlases and the content of social science books, a conceptual framework has been developed for the creation of new maps tailored to the cognitive abilities and educational needs of primary school pupils between the ages of 6 and 10. In the process of creating the new maps, a deliberate attempt has been made to rectify any gaps and omissions identified in the preliminary atlases and social science books. The newly compiled and designed maps aim to be more comprehensive in their professional content, while simultaneously ensuring greater accessibility, clarity, and comprehension for the specific age group they target. The aforementioned maps were presented and subjected to testing in the presence of pupils from four primary schools located in the city of Tetovo, North Macedonia.

2. Method

The process of assembling, conceptualizing, and designing maps was conducted as an integral component of the preparatory stages involved in creating an atlas intended for primary school pupils in the Republic of North Macedonia. The maps, together with the comprehensive content of the atlas encompassing symbols and tables, were purposefully customized to be compatible with the cognitive capabilities, age group, and spatial reasoning proficiencies of primary school pupils. Initially, prior to commencing the cartographic work integrated into the atlas, an in-depth analysis of the contents of social science textbooks for lower grades, spanning from the second grade to the fifth grade, was conducted. In addition to examining the social science textbooks, a review of the atlases utilized by primary schools, irrespective of their designated age range, has been conducted. As an integral aspect of the atlas, the initiative commenced with the design and compilation of symbols employed within the maps. Initially, a comprehensive analysis and study of the symbols were undertaken, followed by their compilation. Subsequently, to assess the pupils' comprehension and interpretation of these symbols, a testing phase was implemented, involving students from the second to fifth grade in primary schools. Subsequent to this phase, the compilation and design of the maps featured in this study were initiated. The compilation, interpretation, visualization, and design of maps specially for the atlas were conducted using QGIS (Quantum GIS) software. All the maps featured in the atlas have been meticulously compiled and designed exclusively for this project, starting from scratch to ensure their uniqueness and relevance. The pupils from the selected schools for the atlas presentation were categorized into two groups: the first group, which did not partake in the atlas presentation, exercises, and practices; and the second group, which actively participated in the atlas presentation, along with associated exercises and practices. Both groups underwent a pre-atlas test and a post-atlas test aimed at assessing their general understanding of maps, geographic orientation, and spatial concepts, and to measure the knowledge gained from the information given inside of the atlas. These results were intended to evaluate the pupils' overall comprehension of maps, atlases, geographical

knowledge, spatial orientation, and related topics. Simultaneously, the aim is to derive the outcomes regarding the efficiency and effectiveness of the compiled atlas. The outcomes of the first group of tests are included in this paper. The final segment of this study involved the compilation and design of representative population tables, which are also incorporated as a constituent part of the atlas.

2.1. Designed maps

The atlas encompasses a variety of maps encompassing diverse facets of North Macedonia's geography, economy, and culture. These meticulously crafted maps employ a visually straightforward and accessible language, incorporating colors and symbols that facilitate comprehension among young readers. The maps developed specifically for the atlas purposefully encapsulate various subjects and their respective contents. In total, the atlas comprises eight foundational maps, each characterized by distinct thematic content, as outlined below:

- Political map of North Macedonia – Map of Municipalities
- Administrative map of North Macedonia – Map of cities
- Map of the Regions of North Macedonia
- Physical map of North Macedonia
- Tourism and Economy map of North Macedonia
- Agricultural map of North Macedonia
- Farming map of North Macedonia
- Climate map of North Macedonia

Within the scope of the Tourism and Economy map of North Macedonia, there are an additional eight supplementary maps that correspond to the eight regions of the Republic of North Macedonia. These auxiliary maps serve to provide detailed information and insights specific to each region. The breakdown of the regions and their respective auxiliary maps is outlined below:

- Tourism and Economy map of Polog Region
- Tourism and Economy map of Skopje Region
- Tourism and Economy map of Northeast Region
- Tourism and Economy map of Eastern Region
- Tourism and Economy map of Southeast Region
- Tourism and Economy map of Vardar Region
- Tourism and Economy map of Pelagonia Region
- Tourism and Economy map of Southwest Region.

3. Results

3.1. Political map of North Macedonia – Map of Municipalities

The Political map of North Macedonia, particularly the Map of Municipalities, has proven to be a valuable educational resource in introducing primary school pupils to the concepts of local governance and administrative boundaries. The map enables pupils to readily recognize their own municipality as well as neighboring municipalities, fostering their

comprehension of local government operations. Notably, each municipality is labeled on the map, facilitating pupils' ability to locate and identify various regions within North Macedonia. Moreover, this map enhances their understanding of the broader political structure of the country. Figure 1 below, displays the Political map of North Macedonia or the Map of Municipalities:

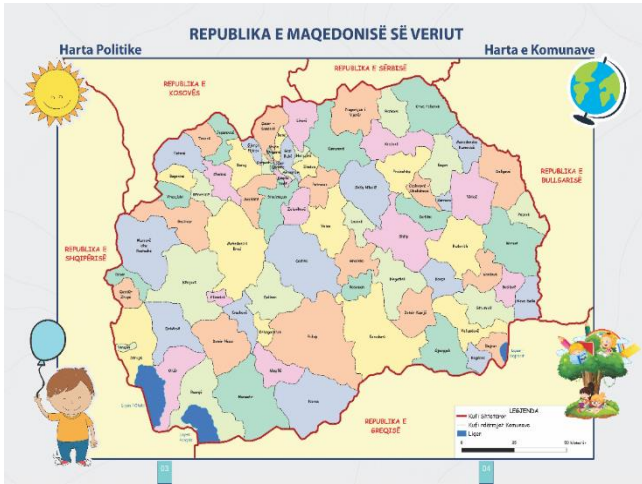


Figure 1. The political map or municipalities map of North Macedonia, designed and used for the Atlas

3.2. Administrative map of North Macedonia - map of cities

The purpose of this map is to facilitate the comprehension of North Macedonia's administrative structure and the various levels of government within the country. The cities and towns depicted on the map are labeled with clarity, enabling pupils to readily identify and locate them. Consequently, pupils have demonstrated the ability to easily recognize their own cities as well as neighboring ones. This map provides the corresponding names of the cities, thus enabling pupils to effortlessly locate and identify distinct areas within North Macedonia. This fosters a better understanding of how these areas fit into the broader political framework of the country. Figure 2 below, presents the Administrative map of North Macedonia or the Map of Cities:

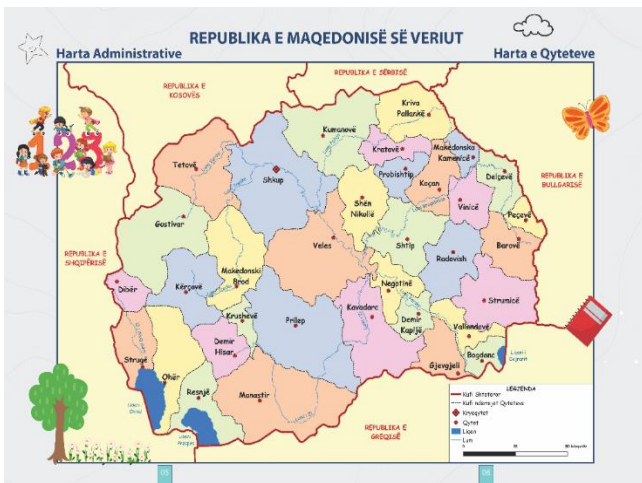


Figure 2. The administrative map or map of cities of North Macedonia, designed and used for the Atlas

3.3. Regions map of North Macedonia

The Regions map of North Macedonia serves as a significant educational tool for pupils, facilitating their comprehension of the country's diverse geography. This map offers valuable information concerning the geographical locations of the various regions. By studying this map, pupils can enhance their understanding of the distinct characteristics that define each region. Consequently, they gain insights into how geography can influence culture, resulting in diverse customs, traditions, and ways of life across different regions. Beyond providing knowledge about North Macedonia's regions, this map also promotes the development of critical thinking and analytical skills among pupils. Figure 3 below, presents the map of the regions of North Macedonia:



Figure 3. The map of regions of North Macedonia, designed and used for the Atlas

3.4. Physical map of North Macedonia

The Physical Map of North Macedonia serves as a comprehensive resource illustrating the country's natural landscapes, encompassing mountains, rivers, lakes, and other geographical attributes. This map plays a pivotal role in enabling pupils to acquaint themselves with the diverse natural environment of their homeland. Through the study of this map, pupils can gain insights into the country's topography. For instance, they can observe that mountainous regions exhibit lower temperatures and higher precipitation levels compared to lowland areas. The map also highlights significant physical features of North Macedonia, such as Lake Ohrid, renowned as one of Europe's oldest and deepest lakes, and the Vardar River, the country's longest and most prominent river. Familiarizing themselves with these natural landmarks allows pupils to cultivate a profound understanding of North Macedonia's distinctive geography and its significance within the Balkan region. Figure 4 below, presents the physical map of North Macedonia:

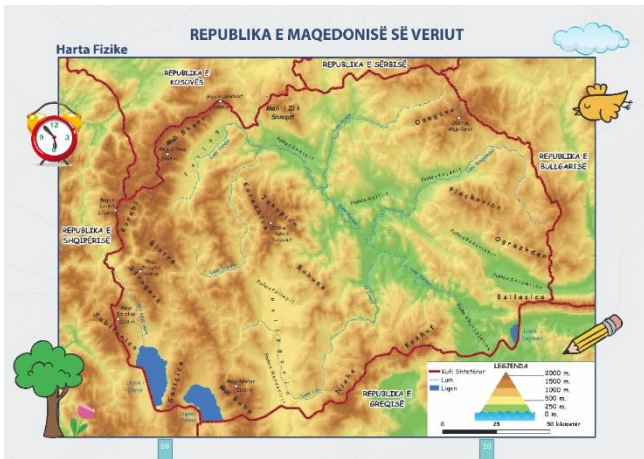


Figure 4. The physical map of North Macedonia, designed and used for the Atlas

3.5. Tourism and Economy map of North Macedonia

The tourism and economy map of North Macedonia presents a wide range of prominent landmarks, attractions, and natural resources, offering young learners valuable insights into the diverse tourism and economic prospects within their country. This map serves as a tool to assist pupils in developing an appreciation for the natural splendor of North Macedonia, while also facilitating their understanding of how these resources contribute to the local economy. By exploring this map, pupils can familiarize themselves with key touristic destinations and gain knowledge about the economic activities associated with various regions. This map provides an opportunity for pupils to comprehend the interplay between tourism and the economy, enabling them to recognize the significance of these sectors within North Macedonia. Figure 5 below, illustrates the touristic and economic map of North Macedonia:



Figure 5. The tourism and economy map of North Macedonia, designed and used for the Atlas

3.5.1. Tourism and economy map of Polog Region

The tourism and economy map of the Polog region has been specifically designed to facilitate the comprehension of primary school pupils regarding the various economic activities within the region and their

relationship with the tourism industry. The map encompasses key towns and cities within the region, along with significant tourist attractions and activities. Among these, the city of Tetovo, situated in the western part of the region, holds prominence as a major tourist destination owing to its historic Ottoman-era structures, notably the renowned Painted or Pasha's Mosque, the Stone Bridge known as Tabak Bridge, and the Castle or Fortress. Additionally, the nearby Shar Mountain National Park entices nature enthusiasts and sports enthusiasts alike with its picturesque landscapes, extensive hiking trails, and the well-regarded ski resort of Sunny Hill (Popova Shapka). The city of Gostivar, situated in the central part of the region, is distinguished by its traditional bazaar and the breathtaking Vardar River canyon. Notably, the city's Clock Tower serves as an important historical and landscape site. In close proximity, the ski resort of Mavrovo draws numerous visitors during the winter months, while the Mavrovo National Park remains a year-round attraction due to its natural splendor and diverse recreational activities. Beyond tourism, the Polog region encompasses several significant industries and agricultural pursuits in its rural areas. The touristic and economic map of the Polog region, provides a visual representation in the Figure 6 below:

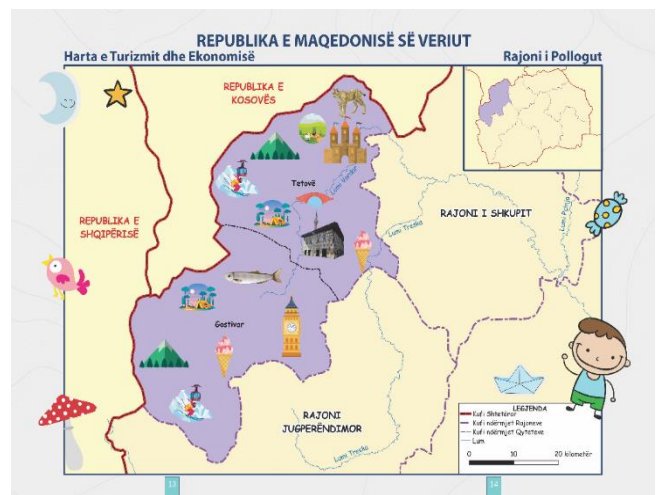


Figure 6. The tourism and economy map of Polog region of North Macedonia, designed and used for the Atlas

3.5.2. Tourism and economy map of Skopje Region

The Skopje Region, situated in the heart of North Macedonia, stands as the most populous region within the country and encompasses the capital city of Skopje. Renowned for its rich cultural and historical legacy, as well as its vibrant tourism and economic sectors, the Skopje Region holds significant prominence. The tourism map of the Skopje Region serves as a comprehensive guide for visitors to explore the diverse array of attractions offered within the region. These include esteemed historical landmarks like the Skopje Castle or Fortress, the iconic Stone Bridge, the Skopje Aqueduct, Mustafa Pasha Mosque, the Clock Tower, and captivating natural wonders such as Mount Vodno and Matka Canyon. Additionally, the tourism and economy map of the Skopje Region provides valuable insight into the

various industries propelling the local economy. Through the utilization of the atlas in classroom settings, pupils gain a comprehensive understanding of the region's cultural and natural heritage, as well as the myriad economic prospects available to them. The touristic and economic map of the Skopje region, serves as an valuable resource in this regard, in the Figure 7 below:

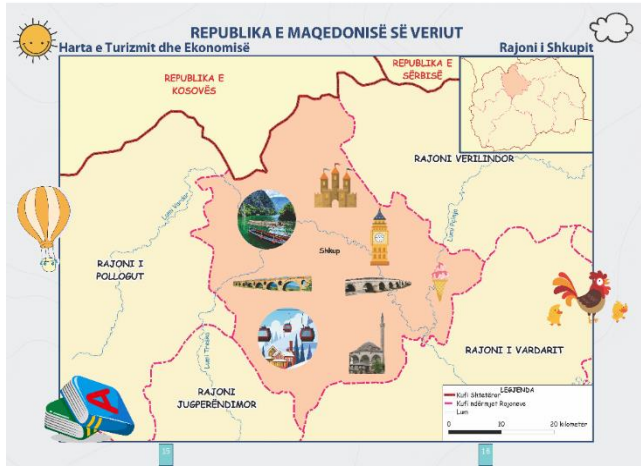


Figure 7. The tourism and economy map of Skopje region of North Macedonia, designed and used for the Atlas

3.5.3. Tourism and economy map of Northeast Region

The Northeast Region of North Macedonia encompasses a diverse and captivating area that presents numerous prospects for both tourism and economic growth. This region comprises the municipalities of Kriva Palanka, Kumanovo, Kratovo, and Probistip. Within the Northeast Region, the town of Kratovo stands out as a primary tourist attraction, renowned for its medieval architecture and illustrious history. Notably, the town is adorned with a distinctive bridge, known as the Stone Bridge, which boasts a storied heritage. Other significant historical sites within the region include the St. George Monastery in Kumanovo, the central square of Kumanovo aptly named New Yugoslavia, the Monastery of Joakim Osogovski in Kriva Palanka. Beyond its historical and cultural allure, the Northeast Region also presents opportunities for ecotourism. Furthermore, the region is recognized for its contributions to the economy, particularly through its natural thermal bath and agricultural endeavors. Notably, the Northeast Region holds a significant position as a major producer of vegetables and fruits within North Macedonia. The touristic and economic map of the Northeast region, as depicted in Figure 8 below, provides a comprehensive overview of these distinct features and offerings, as follows:

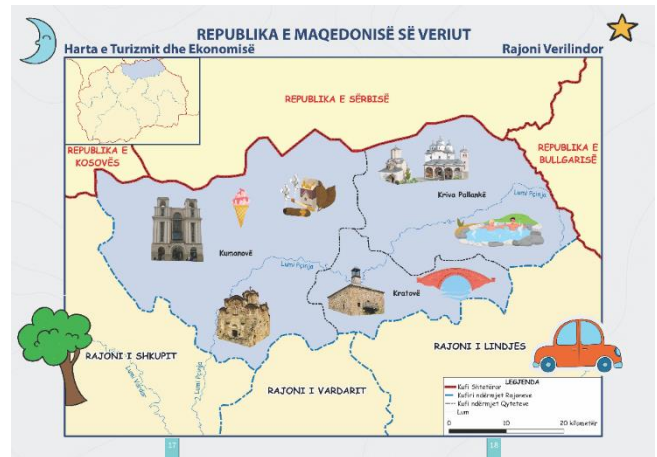


Figure 8. The tourism and economy map of Northeast region of North Macedonia, designed and used for the Atlas

3.5.4. Tourism and economy map of Eastern Region

The Eastern Region of North Macedonia, situated in the eastern part of the country, stands renowned for its abundant cultural heritage and captivating natural splendor. The region boasts a multitude of significant historical sites, drawing in a considerable number of visitors annually. Among the prominent cities within the region, Shtip takes center stage, positioned near the border with Bulgaria. Shtip serves as a vital hub for industry and commerce, flourishing with a robust economy rooted in agriculture. Moreover, the city houses various museums and cultural institutions that celebrate the region's history and traditions, including noteworthy landmarks such as the St. Nikola Church. Another landmark in this region is the St. George Orthodox in the city of Kochan. The Eastern Region also boasts several parks and protected areas, serving as pivotal havens for ecotourism and outdoor recreation. Natural thermal baths are also a characteristic of this region. These natural sanctuaries provide prime opportunities for visitors to immerse themselves in the region's pristine wilderness and engage in leisure activities. The touristic and economic map of the East region, showcased in Figure 9 below, offers a comprehensive depiction of the region's notable features and economic landscape, as follows:



Figure 9. The tourism and economy map of Eastern region of North Macedonia, designed and used for the Atlas

3.5.5. Tourism and economy map of Southeast Region

The Southeast Region of North Macedonia encompasses a diverse and picturesque area that holds significant prospects for both tourism and economic advancement. This region stands distinguished by its abundant cultural heritage, breathtaking landscapes, and a multitude of historical sites. Among the Southeast Region's most sought-after tourist destinations, the city of Strumica takes precedence, renowned for its scenic parks and traditional architecture. Additionally, other noteworthy attractions within this region include Dojran Lake and the spa town of Gevgelija, known for its natural thermal baths. Also, an interesting and important landscape in the city of Gevgelija is the Church of the Ascension of Jesus. An important turistic landscape in this region is the Strumica Fortress or Strumica Castle. In terms of economic development, the Southeast Region exhibits substantial potential in the agriculture and food processing industries. The fertile land within this region provides an ideal environment for cultivating a wide array of crops, including fruits, vegetables, and grains. Furthermore, the region boasts favorable conditions for the growth of the homemade wine industry, benefiting from a longstanding tradition of winemaking. The touristic and economic map of the Southeast region, featured in Figure 10 below, serves as an informative visual aid, offering an overview of the region's notable landmarks and economic opportunities, as follows:

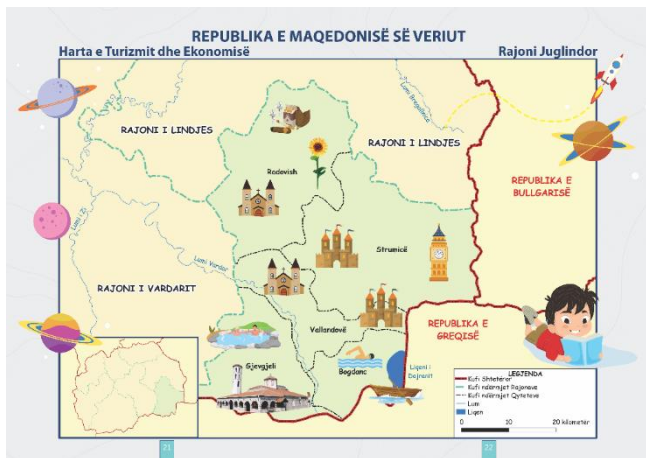


Figure 10. The tourism and economy map of Southeast region of North Macedonia, designed and used for the Atlas

3.5.6. Tourism and economy map of Vardar Region

The Vardar Region, situated in the central part of North Macedonia, occupies a significant position. This region encompasses various popular tourist destinations, including the city of Veles, celebrated for its picturesque mountain landscapes and historical landmarks. Additionally, within the Vardar Region lies the renowned Tikvesh wine region, which entices visitors with its vineyards and opportunities to sample local wines. Another captivating historical site within this region is the ancient city of Stobi, holding considerable appeal for tourists. The St. Pantelejomon Church, located

in the city of Veles, also contributes to the region's allure. Furthermore, the Vardar Region plays a pivotal role as an economic hub for North Macedonia. Notably, it is recognized for its flourishing manufacturing industry, with a focus on food products, and construction materials. The touristic and economic map of the Vardar region, depicted in Figure 11 below, provides an illustrative representation, presenting key attractions and economic features of the region, as follows:

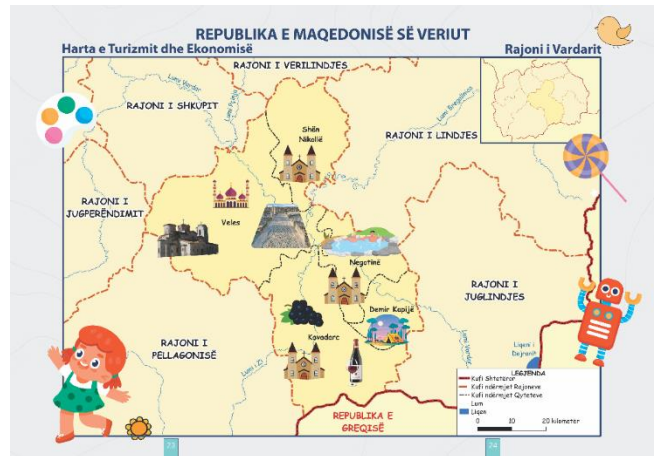


Figure 11. The tourism and economy map of Vardar region of North Macedonia, designed and used for the Atlas

3.5.7. Tourism and economy map of Pelagonia Region

The Pelagonia region, situated in the southwestern part of the country, is renowned for its profound historical significance, rich cultural heritage, and captivating natural landscapes. Offering numerous attractions, the Pelagonia region entices tourists with notable sites such as the city of Bitola, the Pelister National Park, and the Prespa Lake. Bitola, one of the prominent cities within the Pelagonia region, stands out for its historical and cultural prominence. Often referred to as the "city of consuls," Bitola held a significant role in diplomatic affairs. The city boasts a multitude of historical sites, including the Bitola Fortress, the Heraclea Lyncestis archaeological site, the Ishak Mosque, the Alphabet Museum of the Albanian language, and the Clock Tower. These attractions contribute to the city's allure and showcase its rich heritage. The Pelister National Park, a favored destination among tourists, offers opportunities for hiking, skiing, and camping. Additionally, the Prespa Lake, situated in the western part of the Pelagonia region and shared between North Macedonia, Greece, and Albania. The lake boasts a unique ecosystem and serves as a popular spot for birdwatching, fishing, and boating. The St. George Church in the city of Resen and the Makedonium Monument are additional notable attractions within the Pelagonia region. Beyond its tourism appeal, the Pelagonia region holds economic significance for North Macedonia. Notably, the region is recognized for its agricultural activities, particularly the production of apples and cherries. Furthermore, several industrial centers, including the city of Prilep, known for its tobacco production and processing, contribute to the

region's economic vitality. Another turistic lanscapes located in the city of Prilep are the Clock Tower, Bazaar Mosque, Church of St. Cyril, and Methodius and the Prilep Fortress or Prilep Castle. The Galiçica National Park, is a favored destination among tourists, offers opportunities for hiking, skiing, and camping. It also extends along the border of the Pellagonia region and the Southwest region. The touristic and economic map of the Pelagonia region is depicted in Figure 12 below, offering a visual representation of the region's key attractions and economic features, as follows:

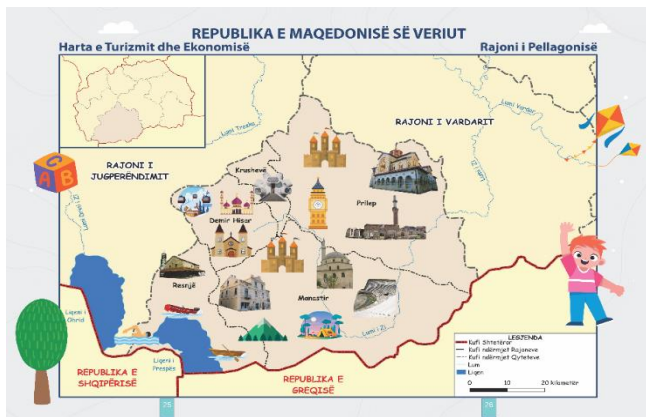


Figure 12. The tourism and economy map of Pelagonia region of North Macedonia, designed and used for the Atlas

3.5.8. Tourism and economy map of Southwest Region

The Southwest Region of North Macedonia is renowned for its abundant cultural heritage, breathtaking natural landscapes, and bustling urban centers. Among its notable features are the cities of Struga and Ohrid, which stand out as both aesthetically pleasing and culturally significant hubs. These destinations attract a substantial number of visitors annually, making tourism a crucial contributor to the region's economy. Beyond its cultural allure, the Southwest Region also boasts several remarkable natural wonders. Of particular note is the Ohrid Lake, situated on the border with Albania and Greece, which serves as a favored tourist destination. The presence of swans and trout fish in Ohrid and Struga further enhances the distinctive character of these cities. Ohrid Lake, distinguished as one of Europe's oldest and deepest lakes, exhibits a unique ecosystem and supports a variety of endemic species, including fish, snails, and algae. Its ecological significance has earned it the prestigious distinction of being designated as a UNESCO World Heritage Site. Visitors to Lake Ohrid can revel in its crystalline waters, picturesque beaches, and enchanting surroundings. The Clock Tower and the Fortress or Castle in Ohrid are also important turistic landscapes. The Galiçica National Park, is a favored destination among tourists, offers opportunities for hiking, skiing, and camping. It also extends along the border of the Pellagonia region and the Southwest region. The city of Dibra or Debar boasts notable attractions such as the statue of Skanderbeg and the Monastery of St. Jovan Bigorski, situated nearby the city. Additionally, the city of

Kiçevo or Kërçova is home to the Monastery of St. Bogorodica, while showcasing the traditional national clothing of Albanians. These sites contribute to the cultural wealth of the region. In terms of economic dynamics, the Southwest Region relies not only on tourism but also on agriculture and industry. Agriculture holds a prominent position within the regional economy, with numerous small-scale family farms producing fruits, vegetables, and livestock. The tourism and economic map of the Southwest region is presented in Figure 13, providing a visual representation of the region's key tourist attractions and economic features, as follows:

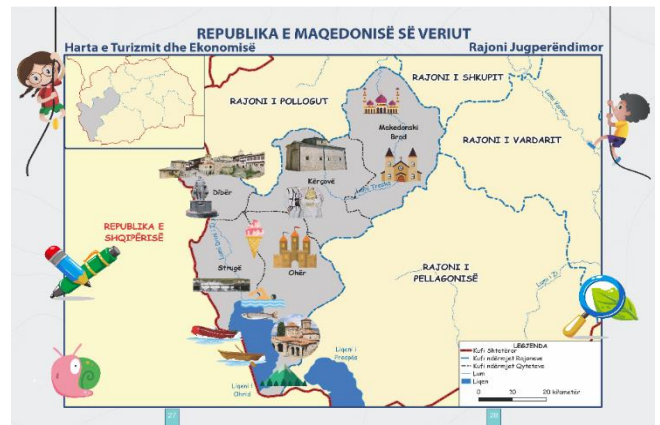


Figure 13. The tourism and economy map of Southwest region of North Macedonia, designed and used for the Atlas

3.6. Agricultural map of North Macedonia

The agricultural map serves as a valuable resource for acquiring insights into the agricultural practices prevalent throughout North Macedonia. It offers comprehensive information regarding the types of crops cultivated and the specific regions where these practices are prominently observed. Moreover, the map serves to underscore the significance of agriculture within North Macedonia's economy and its integral role in shaping the country's culture and traditions. Through its visual representation of diverse agricultural practices, the map facilitates pupils' comprehension of the varied landscape utilization for agricultural purposes across the country. This enables pupils to discern the cultivation of distinct fruits, vegetables, and grains in different cities and regions throughout North Macedonia. Complementing the map, concise descriptions and explanations of the agricultural practices are incorporated to enrich pupils' knowledge and deepen their understanding of the subject matter. The use of symbols and color-coded indicators further assists pupils in identifying and distinguishing between various crops, promoting clarity and comprehension. The agricultural map of North Macedonia is depicted in Figure 14, visually conveying the aforementioned information, as follows:

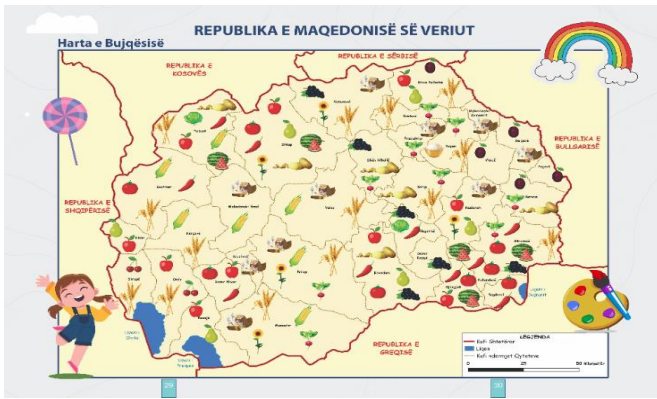


Figure 14. The agricultural map of North Macedonia, designed and used for the Atlas

3.7. Farming map of North Macedonia

The farming map of North Macedonia serves as a crucial resource for comprehending the country's farming sector. Its purpose is to showcase the various livestock raised by farmers, providing vital information for understanding the significant role that farmers play in the country's economy. The farming map of North Macedonia incorporates several notable features that enhance its accessibility and comprehensibility for young learners. Notably, the utilization of symbols to represent distinct livestock, such as cows, pigs, sheep, and chickens, facilitates the young learners' understanding of the diverse range of animals reared on farms. By familiarizing young learners with these symbols, the farming map effectively conveys the different types of animals found in various cities across the country. Furthermore, the farming map of North Macedonia holds potential as an educational tool for instilling an understanding of sustainable farming practices among young learners. It serves as a means to develop their awareness of the interconnections between the environment, agriculture, and food production. Teachers can leverage the farming map to cultivate a deeper appreciation for the pivotal role played by farmers in society. Consequently, young learners will gain the ability to discern that different cities within the country house diverse animals, birds, and fish. The farming map of North Macedonia is presented in Figure 15, visually representing the aforementioned details, as follows:



Figure 15. The farming map of North Macedonia, designed and used for the Atlas

3.8. Climate map of North Macedonia

The climate map of North Macedonia encompasses a comprehensive representation of the country's various climatic zones, shedding light on distinct temperature ranges, precipitation levels, and other pertinent climatic characteristics associated with each zone. For instance, the western part of the country exhibits a Mediterranean climate characterized by mild winters, and hot, arid summers. Conversely, the eastern part, northeast part, and northwest part experiences a continental climate typified by cold, snowy winters and hot summers. The integration of the climate map within the Atlas serves as a valuable resource for young learners, enabling them to comprehend the diverse climatic conditions prevalent in North Macedonia and their consequential impacts on the country's flora, fauna, and overall environment. Additionally, the map offers insights into the suitability of specific regions for cultivating different types of crops and sheds light on the repercussions of climate change on the agricultural sector. Moreover, the climate map holds the potential to function as a powerful tool for fostering environmental awareness and education. Pupils can garner knowledge concerning the influence of human activities on climate change and explore ways in which they can contribute to environmental preservation. Furthermore, the map can be employed to educate pupils on the importance of water conservation and sustainable agricultural practices. The climate map of North Macedonia is presented in Figure 16 below, providing a visual depiction of the aforementioned climatic details, as follows:

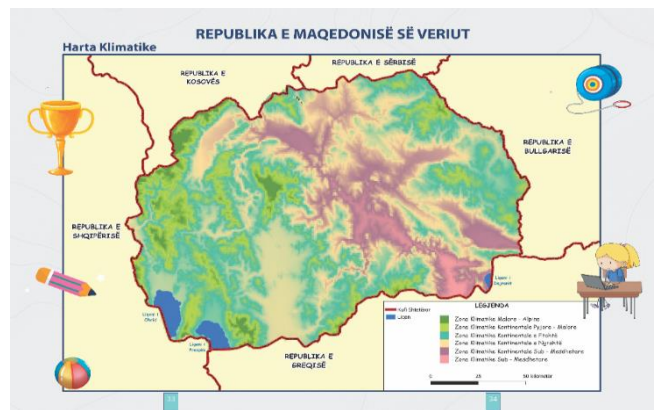


Figure 16. The climate map of North Macedonia, designed and used for the Atlas.

4. Discussion

Prior to commencing the design and compilation of the anticipated maps for the atlas, a comprehensive examination of the existing working materials, particularly the preliminary atlases currently utilized by pupils within the educational system, was conducted. This review encompassed a thorough assessment of the social science textbooks utilized in the second, third, fourth, and fifth grades. At least two books per class were carefully examined and subject to necessary revisions. In this context, the designed maps are intended to be comprehensible to children in accordance with their

cognitive development, perception abilities, and level of knowledge.

Throughout the process of designing and compiling maps, significant emphasis has been placed on the utilization of symbols that are employed within the maps, which some of them are also represented as an example in Figure 17 as Part 1 and Figure 18 as Part 2. These symbols have been specifically devised and assembled to align with the cognitive development of the pupils. All symbols are depicted along with their corresponding names and the respective city or region they represent.



Figure 17. Symbols that are used within the atlas maps, sorted according to usage within the maps – Part 1.

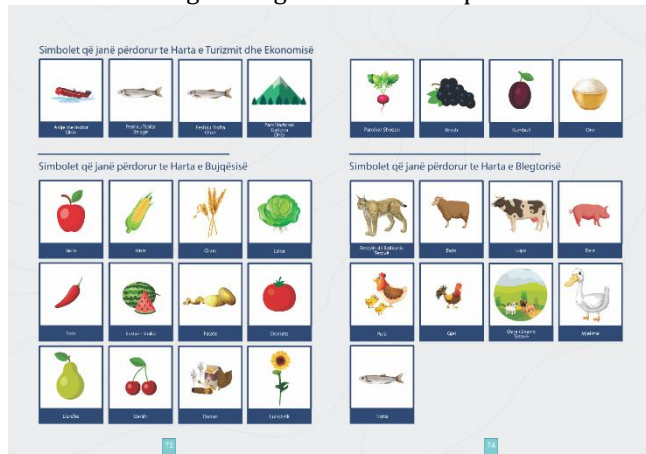


Figure 18. Symbols that are used within the atlas maps, sorted according to usage within the maps – Part 2

Thorough testing and validation of the symbols have been conducted, guided by the outcomes of the tests. A comprehensive test involving 567 primary school pupils across different grades confirmed the clarity and comprehensibility of symbols; results indicated a strong understanding of symbols representing common elements but a lower familiarity with symbols depicting landmarks or objects from various cities. The success percentages, depicted in the table, delineate the performance levels across different classes. Specifically, the results indicate success rates of 54.90%, 61.10%, 65.15%, and 69.77% for second, third, fourth, and fifth-grade classes, respectively. The overall success percentage, calculated as an average across all classes, stands at 62.73%. These findings suggest a progressive improvement in symbol comprehension skills as students advance through the primary school grades.

The data underscores the effectiveness of the symbol-based testing approach and provides valuable insights for educators seeking to tailor map comprehension strategies to specific grade levels (Jonuzi & Selvi, 2023). Two tests were conducted with distinct pupil groups to optimize map presentation quality. The first group was undertaken with pupils that did not participate in the Atlas presentation and the second group is going to be undertaken with pupils that will participate in the atlas presentation. The questions of the pre-atlas tests and post-atlas tests are presented in the tables 1, 2 below:

Table 1. Pre-atlas test questions

| Questions |
|---|
| Q. 1. Which of these states does the Republic of North Macedonia not share a border with? |
| Q. 2. What is the number of regions in the Republic of North Macedonia? |
| Q. 3. In which region of North Macedonia does the city of Bitola belong? |
| Q. 4. What is the number of cities in the Republic of North Macedonia? |
| Q. 5. What is the capital city of the Republic of North Macedonia? |
| Q. 6. What is the number of municipalities in the Republic of North Macedonia? |
| Q. 7. How many natural lakes does North Macedonia have? |
| Q. 8. What is the largest natural lake in North Macedonia? |
| Q. 9. What is the largest river in North Macedonia? |
| Q. 10. What is the highest mountain in North Macedonia? |
| Q. 11. What is the symbol of the city of Skopje? |
| Q. 12. Which state does North Macedonia share a border with in the east? |
| Q. 13. What is the largest plain in the Republic of North Macedonia? |
| Q. 14. The relief of the Republic of North Macedonia is predominantly characterized by? |
| Q. 15. What is the resident population count in the Republic of North Macedonia? |

Table 2. Post-atlas test questions

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

According to the group of pupils that did not participate in the atlas presentation, the results of the pre-atlas test are as follows; In this comprehensive study involving 339 primary school pupils from the 3rd to the 5th grade, aged 7 to 10 years, stratified into female (160 participants) and male (179 participants), a pre-atlas test was conducted to assess general knowledge related to the Atlas. Question 8 showed the highest average correctness at 73.49%, while question 6 exhibited the lowest at 15.79%. According to categories of questions, analysis of data reveals that Category C (Tourism and Economy in North Macedonia) had the highest mean accuracy (49.39%), followed by Category B questions (Directions, geographical regions, and neighboring areas) with 37.22%. Category A (Map and Atlas concepts) having the lowest mean accuracy (18.74%) is at the end of the list. Regarding gender differences, the female pupils group from 3rd to 5th grade achieved an accuracy rate of 38.54%, while the male pupils from 3rd to 5th grade achieved a rate of 38.28% of the answers. The study provides valuable insights into the performance of primary school pupils in atlas-related assessments, highlighting variations in accuracy across different question categories and gender groups.

According to the group of pupils that did not participate in the atlas presentation, the results of the post-atlas test are as follows; A comprehensive cohort of 339 primary school pupils, aged 7 to 10 years and spanning grades 3 to 5, were stratified into female (160 participants) and male (179 participants) groups. They actively participated in the post-atlas test, assessing their general knowledge related to the Atlas, and the subsequent table showcases the outcomes of this assessment. Question 13 exhibited the highest average correctness at 60.89%, while question 3 had the lowest average at 10.78%. Data analysis reveals that questions within Category A (Map and Atlas concepts) had the highest mean accuracy with 50.29%, followed by Category C (Tourism and Economy in North Macedonia with 32.38%. Category B (Directions, geographical regions, and neighboring areas) exhibiting the lowest mean accuracy with 29.96% is at the end of the list. Regarding gender differences, the female pupils group from 3rd to 5th grade achieved an accuracy rate of 32.89%, while the male pupils group from 3rd to 5th grade achieved a rate of 35.52% of the answers. This study provides valuable insights into the post-atlas test performance of primary school pupils, highlighting variations in accuracy across different question categories and gender groups.

Throughout this entire process, the inclusion of opinions and attitudes from lower grade primary school teachers has been deemed essential. To gather their input, two surveys were planned to be developed; one conducted prior to the atlas presentation and the other conducted after the atlas presentation. These surveys aim to gauge the teachers' perspectives and insights on the effectiveness of the maps and the atlas in the classroom setting.

The design of the maps and the overall atlas was specifically tailored to meet the needs of lower grade primary school pupils. All analyses and testing conducted

were aimed at ensuring that the maps and the atlas were comprehensive and professional in terms of visual presentation, design, and aesthetics. The primary objective was to create a visually appealing and engaging atlas that effectively catered to the educational requirements of young pupils.

5. Conclusion

The maps compiled, designed, and presented in this study are part of the "Atlas of North Macedonia for Primary Schools" project. This project is an integral component of the author's diploma study and thesis. The maps included in this study adhere to established guidelines and frameworks for designing and compiling maps specifically tailored for children. The aim is to establish a new standardization within the territory of the Republic of North Macedonia in this context. Historically and presently, there has been a lack of map categorization based on children's age groups. Through the design of these maps and the atlas, a new era of standardization in this domain is proposed.

In essence, the "Atlas of North Macedonia for Primary Schools" serves as a valuable educational resource for children aged 6 to 10, providing a comprehensive exploration of the historical, geographical, cultural, and environmental aspects of North Macedonia. The atlas incorporates a diverse range of maps, each carefully crafted to engage and facilitate learning for this specific age group. These maps include the Political Map of North Macedonia, which highlights municipalities, and the Administrative Map of North Macedonia, showcasing cities. The atlas also features maps focused on the regions of North Macedonia, physical geography of the country, tourism and economy map (accompanied by individual maps for each of the 8 regions as part of the country), agriculture map, farming map, and climate map. The design and presentation of these maps have been thoughtfully executed to ensure accessibility and captivate the interest of the target audience.

Each map within the atlas provides significant details pertaining to the various regions, cities, provinces, and municipalities of North Macedonia, encompassing their cultural, historical, geographical, and natural characteristics. The concise descriptions and accompanying information within each map offer a comprehensive glimpse into the political, economic, and environmental aspects that define North Macedonia's landscape.

To summarize, the Atlas serves as a significant educational tool, fostering a deeper understanding and appreciation among pupils for the diverse facets of North Macedonia, including its rich history and captivating natural landscapes. Moreover, the atlas acts as a catalyst for stimulating curiosity, motivating pupils to explore and delve further into the country's culture and environment, extending beyond the confines of the classroom. Ultimately, the Atlas provides an effective and captivating approach to familiarizing young learners with the geography and cultural aspects of North Macedonia, nurturing a passion for learning, and

cultivating a profound appreciation for the world they inhabit.

Author Contributions

The authors all contributed equally to the study.

Statement of Conflicts of Interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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