Developing Geographical Literacy in Students with Dyslexia: Challenge and Reflection

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Abstract

This study addresses issues related to the development of geographic literacy by describing, explaining, and discussing these issues as they related to the development of students' spatial thinking through the teaching of geography at school. This topic is explored, because in all Geography curricula and reform movements in teaching of geography, the emphasis is placed on the importance that geographic knowledge and skills (geographic literacy) have in preparing students to become informed and active citizens. Emphasis in this research is placed on how these abilities can be developed in students with learning difficulties, in our case in students with dyslexia. In addition, the study emphasizes the importance of effective teaching of geographic literacy in these students. Researches have shown that there is a lack of activities related to geography, particularly in the context of a diversified teaching, for students with these "special learning abilities". In this study review of the literature is intended as a search for ideas, strategies, educational tools and ways to effectively reach the population of students with learning difficulties, especially with dyslexia, to develop their geographic literacy and spatial abilities.

Keywords: spatial ability, geographic literacy, education, students, dyslexia

Introduction

In our rapidly changing, interdependent, and complex world, the importance of "the geographic advantage" (Hanson, 2004) and geography education is evident. Geography education provides critical preparation for civic life and careers in the 21st century. In the modern world, every member of society increasingly is called on to make decisions that have far-reaching consequences and geography education helps prepare people to make these decisions (Bednarz et al., 2013). Undoubtedly, everything in people's daily life is interwoven with geography and of course geographic knowledge enable people to understand things they do daily and how every day actions affect the world around them (Klonari & Passadelli, 2016). Finally, geography explains where the places are, how the landscapes were formed, how people and environments interact and how a series of different economies, societies and environments are linked to each other (Klonari & Mandrikas, 2014). Consequently, people must focus on the development of

"geographical thinking" in order to understand the relationship and interdependence of man and space. In geography, the shaping and modulation of human perception, emotion and behaviour are effectuated through the multiplicity and complexity of interactions and interrelationships between humans and both time and space (Pavlis & Terkenli, 2010). So, geography education is the one that will help to develop the human spatial consciousness.

It is also well known that spatial thinking is a central component of geography. It means that spatial thinking has always been a fundamental cognitive skill for competency in geography, as space is a key organizing concept for it. Spatial thinking can be defined as a constructive combination of cognitive skills comprised of knowing concepts of space, using tools of representation, and applying processes of reasoning (NRC, 2006). Spatial thinking allows people to use space to model the world (real and theoretical), structure problems, find answers, and express and communicate solutions. The inclusion of concepts of space makes spatial thinking unique from other types of thinking (NRC, 2006). Location, scale, pattern, spatial association, analogy, network, and proximity are examples of spatial concepts that have been explicitly recognized by researchers (Gersmehl and Gersmehl, 2007; Golledge, 2002; Janelle and Goodchild, 2009). Moreover, tools of representation such as maps, graphs, sketches, diagrams, images, and models enable and support spatial thinking. Spatial thinking often necessitates complex reasoning (Jo & Bednarz 2009). Reasoning is the capacity of individuals to think, make sense of the world, and understand. Processes of reasoning include low levels of thinking, such as recognizing, defining, and listing, and higher levels of thinking, such as evaluating, synthesizing, and generalizing (Jo & Bednarz 2009). Recently, much interest has been generated, theoretically and pedagogically, in the issue of spatial thinking, because of its importance in science, technology, engineering, and mathematics (STEM) education and everyday activities (Hegarty 2010; Newcombe 2010). For example, research has shown that students' success in STEM areas significantly correlates with their spatial abilities (Keehner et al. 2004; Kozhevnikov et al., 2007).

Current trends in teaching spatial thinking in education have raised important debates on human development of spatial thinking. Many researchers have attempted to conceptualize the development of spatial thinking. These theories can be grouped into four broad categories: nativist, Piagetian, Vygotskyan, and interactionist (Kim et al. 2012). Educational approaches for fostering spatial thinking typically utilize an interactionist approach because it recognizes that individuals have different starting points for spatial thinking, but spatial skills can be improved through training and scaffolding. An interactionist approach provides teachers and policy makers with the opportunity to consider a wide range of educational strategies. Even though students bring different spatial thinking approaches and preferences to the classroom, tools of representation paired with quality instruction can enhance and develop multiple strategies for spatial thinking (Metoyer et al., 2015).

Black (2005) supports that spatial thinking is a skill that must be emphasized in secondary education. But in traditional education this seems to have been neglected. This means insufficient spatial abilities which will be more obvious to students with weaknesses, who may later avoid studying disciplines related to the science, mathematics, or environment.

Because heterogeneity is a phenomenon which is observed in all-natural beings, the same heterogeneity is also observed in humans in various fields. Differences exist in external appearance, sociability, interests, way of thinking, cognitive functions, etc. In this case our interest focuses on the difference student's spatial thinking and more specific in spatial thinking of dyslexic students.

Dyslexia is one of several distinct learning disabilities. Children with learning disabilities often struggle with various areas of academic performance. Baddeley (2002), states that children with specific difficulties in learning obtained essentially lower results, which proves that there exist problems within the working memory which comprises also the so called *visuospatial notes* – a system processing spatial information which reaches the brain by means of sight. Dyslexia, therefore, is a special learning disorder that is associated with learning weaknesses, with mistakes in orientation and sequence of the symbols and with psychosocial difficulties that affect the child's learning, emotional and social development (Tsovilli, 2003).

Methodology- context of the study

Research question

The central question this review paper attempts to answer whether Geography helps to develop dyslexic student's spatial thinking. However, the objective of the paper is to review the literature of the last 14 years (2003-2017) with intention to:

- Present if there is relationship with dyslexia and spatial perception
- Creating appropriate educational material and selected application in schools can help effectively learn and retrieve geographic skills?
- There is a difference in the spatial thinking and geographic performance of students with dyslexia compared to non-dyslexic students?

Data collection

Databases searched

In order to answer our research questions, we reviewed the literature of published studies and the grey literature for the past 14 years, 2003-2017. We decided to search for articles written in English and published in scientific journals. We exclude from this review books, chapters and conference papers. The literature search was undertaken in December 2017 and January 2018 in the following international online bibliographic databases: a) OPAC (University of Aegean) b) Oxford University Press (Journals) c) ERIC (Education Resources Information Center d) SAGE e) Taylor Francis.

Search Terms

Searches were made using the following keywords: education or geography or secondary education or teaching geography and dyslexic students or spatial thinking and dyslexic students or visual-spatial talent or spatial ability or gifted students.

Selection of papers for inclusion in the review

A number of the further criteria were specified to select appropriate articles for inclusion in the review. This study focused on dyslexic student's geography performance and their visuo-spatial skills. However the articles that we wanted to include in this review should be related to geography teaching in secondary schools, visuo- spatial ability and dyslexic students simultaneously. The criterion greatly narrowed our research because in the 6 electronic databases that we searched, we could find and include only 12 papers in the review, based on quantitative analysis. We excluded some papers that referred to: a) teacher's perceptions about dyslexia, b) studies related to elderly or younger people, c) papers that investigated other learning disabilities d) articles that referred to dyslexic student's attitudes in language lessons. We found a few articles linking three concepts. Some publications may have been missed if they did not match-up to our keywords. The numbers of papers identified from each data base and the number of papers included in the review are presented in Table 1.

Table 1: Total number of reviewed papers identified from each database and number of papers included in the review.

Database	Numbers of papers identified in search	Number of papers meeting inclusion criteria
ERIC	0	0
Heal- Link	0	0
Oxford University Press	0	0
Springer Link	4	1
MIT press	0	0
Ideal Library	1	0
Research Gate	2	0
Science Direct	8	4
Taylor Francis	41	0
Gabridge University press	0	0
Wiley Online Library	2	0
Google scholar	9	6
Total	67	11

Table 2: Authors and issues in each paper

Author (year)	**Geography**	**Visuospatial skills**	**Dyslexia**	**Reading and language skills**
Oldakowski (2001); Huynh & Sharpe (2013); Herman (1996); Jo & Bednarz (2014); Lee et al.	✓	✓		

(2017); Dunn (2011); Manson et al (2014); Self & Colledge (1994); Nodenot et al (2010); Metoyer & Bednarz (2017); Harris et al (2010); Collins 2017				
Konecny & Stanek (2010); Lane & Bourke (2017); Preston (2014); Lidstone & Stolman (2006); Dunn & Darlington (2016); Maude 2017; Beneker et al (2015); Bourke & Lane (2017)	✓			
Davis & Deponio (2014); Faramarzi et al (2017); MacDougall (2009); Skinner (2011); MacCullagh (2014); Hoyles & Hoyles (2010); Regan & Woods (2000); Cancer et al (2016); Crisp et al (2012); Lawson et al (2013); Simon (1998)			✓	
Finesilver (2017); Lee & Bednarz (2012); Tomaszwski (2015); Gersmehl & Gersmehl (2007)		✓		
Faramarzi et all. (2017); Skotun & Skoyles (2008); Nielsen & Paech (2004); Heimdahl- Mattson et al (2010); Valdois et al (2004)			✓	✓
Chan (2009); Aleci et al (2012); Bacon et al (2007); Karolyi et al (2003); Giovagnioli et al (2016); Brunswick et al (2010); Magnione et al (2015)		✓	✓	✓
Allegri (2015); Wang & Yand (2011); Koutsopoulos et al (2017); Duranovic et al (2015)	✓	✓	✓	

Table 3: Articles meeting inclusion criteria

Author (year)	**Students**	**Educators**	**Questionnaires-Tests**	**Teaching strategies**
Khasawneh (2012); Duranovic et al (2014); Aleci et al (2012); Wnag- Yang (2011); Koutsopoulos et al (2017); Giovagnioli et al (2016); Brunswick et al (2010)	✓		✓	
Karolyi et al (2003); Allegri (2015); Bacon et al (2007); Chan (2009)	✓			✓

Results

Our search yielded 67 publications that seem to meet the initial criteria, all of which were in peer reviewed journals. Reviewing these papers 55 were discarded, leaving 11 for this

review. The reasons for rejections were that these articles did not combine all three or at least the two scientific fields studied by the review. From Table 2 it appears that 26 articles study geographic literacy and from these, 16 refer to geospatial thinking. We also found 34 papers on dyslexia, but 17 were rejected because they only mentioned the issue of dyslexia without looking at the parameters of interest and the 6 who are studying the children with dyslexia reading and language skills.

After the study of the papers, the researchers' views were categorized.

A). Dyslexia and frequency of the phenomenon

Dyslexia is a learning disability that has been discovered and studied over the last hundred years. Dyslexia is one of the most carefully studied types of learning disabilities, affecting more than 80% of all individuals identified as learning disabled (Tafti et al, 2014).

Dyslexia has been associated with deficits in left hemispheric function and brain imaging has suggested that such individuals use right hemisphere resources during reading tasks whereas people without dyslexia present left hemisphere activation (Bacon et al., 2007). Most definitions of dyslexia refer to language deficits. This is shown in Table 2 and the definitions set out in the articles studied in this review. Developmental dyslexia is a specific reading disability that affects approximately 4-10% of the population of school age (Aleci et al., 2012; Kotsopoulos et al., 2017; Bacon et al., 2007). There is a similar view (Giovagnoli et al., 2016; Magnione et al., 2015; Karolyi et al., 2003; Allegri, 2015; Wang & Yang, 2011; Khasowneh, 2012) who argue that developmental dyslexia is a specific learning disorder characterized by persistent difficulties in learning how to read accurately, fluently and in reading comprehension caused by multiple genetic and environmental risk factors, as well as their interplay. Some have even reported that except linguistic deficits and visuospatial deficit is characteristic of dyslexia (Brunswick et al., 2010).

The frequency of dyslexia varies between countries as well as between researchers. Wang & Yang (2011) believe that it is estimated that 15% of boys and 5% of girls of average intelligence fail to learn, to read and write due to dyslexia.

B). Dyslexia and visual-spatial ability

From the analysis of the term visual-spatial, we understand that it is the understanding of spatial concepts that organize the external visual space. Researchers' opinions differ on the visuospatial's ability of dyslexic students. Giovanioli et al. (2016) argue that children with dyslexia have deficits in several visual spatial abilities. This is in contrast to the point of view that the individuals with dyslexia have superior visual- spatial processing ability (Duranovic et al., 2015; Wang & Yang, 2011; Bacon et al., 2010). Aleci et al. (2012) found that there is no evidence for enhanced spatial orientation ability in individuals with dyslexia. The studies that we reviewed referred to dyslexic's performance in several fields of spatial thinking and it is obvious that there are different opinions. Duranovic et al. (2015) supports that individuals with dyslexia performed equivalently to those without dyslexia in mental rotations tests while Aleci et al. (2012) believe that students with dyslexia have enhanced ability in the same tests. Giovanioli et al. (2016) have opposite view and they found that children with dyslexia performed significantly worse than normal children in a mental rotation task. Also, there are researchers who argue dyslexic's students are superior and other categories of tests. Individuals with dyslexia had better performance than those without dyslexia in paper folding tests (Duranovic et al., 2015). Furthermore, dyslexic students can distinguish 3D figures more quickly than normal students without higher error rates (Wang & Yang, 2011; Brunswick et al., 2010).

C) Spatial thinking of dyslexic males and females

Many researchers believe that there is difference in spatial skills between males and females and it seems from our review. Brunswick et al (2010) found several sex group interactions: Dyslexic men were more accurate than dyslexic women. The visuospatial advantage in dyslexia may be sex-specific, rather than disorder general. One explanation for the superiority of dyslexic males may be that exceptional visuospatial skills develops at the expense of language skill. A robust finding is the most consistently reported sex difference in cognitive ability is men's superior ability to rotate 3D images (Brunswick et al., 2010). The men's superior highlighted from Karolyi et al (2003) and Brunswick et al (2010) who found that dyslexic females have lower configural orientation than dyslexic males who are more accurate than normal males. Opposite view have Duranovic et al (2015) and Khasawneh, (2012) who argue that dyslexic females are not performed worse than dyslexic males in any visuospatial tasks. This is due to that curriculum does not differentiate between the sexes in terms of preparation and the treatment of teachers with their students equally regardless of their sex (Khasawneh, 2012). One explanation for the superiority of dyslexic males may be that exceptional visuospatial skill develops at the expense of language skills (Brunswick et al., 2010; Bacon et al., 2003).

Conclusions

This paper has presented a 12 year review study focusing on the development of geographic literacy and spatial skills at the age of high school and how spatial skills can be developed in students with dyslexia. The current review has a number of limitations. As with all reviews, it was limited by the search terms used, the scientific databases searched and the period in which the papers were published. However, in Table 2 seems that there are many researches dealing separately with each scientific field from those we are interested in (geographical literacy, spatial thinking, dyslexia). In scientific field of learning disabilities, have been studied parameters such as reading, writing and spelling, the peculiarities and characteristics of spoken language as well as peculiarities in numerical function have been studied. Also, cognitive peculiarities or weaknesses of children in perceptual and cognitive abilities (space-time concepts, frame-type distinction, mnemonic function, etc.) have been investigated. There are very few studies dealing with geographic literacy and geospatial skills of dyslexic students. Specifically, in our search, only four papers were found to investigate optic competence in children with dyslexia. The visuospatial attention is smaller in students with dyslexia than students without dyslexia (Tafti et al., 2014). Also, there is significant difference between dyslexic and normal students to the answering speed (Wang & Yang, 2011; Brunswick et al., 2010). For these reasons it is necessary, the teacher to adapt his teaching based on the skills and deficits of dyslexic students. If educators focus on dyslexic students strengths, it may be possible to improve the effectiveness of their learning (Wang & Yang, 2011). The finding strategies can facilitate student's learning process, even for those with learning disabilities and this also applies to the teaching of geography (Allegri, 2015). The active learning based on a visual approach does the lesson more interesting and the learning more effectiveness. It would also be instructive to investigate in which fields dyslexic are gifted. In this way, we might also discover ways to facilitate and appropriate this different learning ability in people with dyslexia.

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