

CONCEPT MAPPING IN GEOGRAPHY: A REVIEW OF FULL PAPERS IN THE AREA

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Abstract. Geography is a discipline that works with very complex and difficult concepts for students of any level of education, whether it be pre-school or higher education. The concept maps developed by Novak and his colleagues spread throughout the world and it is a powerful strategy that favors teaching and learning. The present study analyzes a review of databases and journals on concept mapping and geography. Twelve full papers were found and categorized, analyzed the importance of concept mapping for teaching and learning in geography. The results are positive and corroborate with other studies that point to the strength of concept maps in education.

Keywords: concept mapping, geography, review

1 Introduction

Concept maps were introduced in the sixties by Novak (1998) and have become a powerful educational resource with a lot of applications. Moreover, concept maps can reveal learners' knowledge organization by showing connections, clusters of concepts, hierarchical levels, and cross-links between concepts from different levels (Shavelson, Ruiz-Primo & Wiley, 2005). Concept maps nowadays have become a commonly used tool in science education and educational research (Novak & Gowin, 1984). Numerous researchers (Kinchin, Hay & Adams, 2000; Cañas et al., 2004; Tarté, 2006; Correia, Cabral & Aguiar, 2016) show that concept maps are an excellent teaching tool to represent organized knowledge.

Since the First International Conference on Concept Mapping (CMC) held in 2004, the use of concept mapping spread to different areas of knowledge. For instance, in Robotics, Schivani & Pietrocola (2014) and McLemore et al. (2016); in Language teaching, Zhang (2014) and Marriott & Torres (2016); in Health, Lee et al. (2013), Wells, Bernal & Bressington (2014) and De Domenico et al. (2014); in Companies, Bizarro (2014) and Moon et al. (2016); in Biology, Schwendimann (2014) and Schwendimann (2016); in Mathematics, Lapp, Nyman & Berry (2010) and Woolcott (2014).

Research on the revision of a scientific area is very important to know what has already been done. Two full papers illustrate very well the importance of the literature review, especially nowadays where we have a very large production in several areas, mainly in the Education Sciences. We can cite two full papers, Daley et al. (2008), Cubillas and Puerta (2014) that make a great review in the CMC papers, separating all publications by universities, area of knowledge, gender, etc.

In this paper, we tried to cover all full papers that involve geography and concept mapping between 2004 (when the first CMC was held) and 2016. This paper aims at analyzing the expansion strategy of concept mapping in the area of Geography. The complexity of geography and its complex concepts, for example: geomorphology, climatology, and geology, pose special challenges for educators. Learners come to the classroom with prior knowledge, which serves as the foundation for further knowledge building. The use of concept mapping can foster meaningful learning for students of various ages, from kindergarten to higher education (Reiska, Möllits & Rannikmäe, 2016; Kinchin, 2014).

To understand this new world perspective, there is no alternative but to rethink the classroom and all disciplines, certainly geography as well. There are several studies (Andrade, 1994; Castellar, 2003; Moreira, 2007) that point out to the scientific and technological progress observed in the current context of society. And the improvement of textbooks was not accompanied by the change in the methodologies used to teach the geographical knowledge in the school. The potential and powerful uses of concept maps as a learning tool is well exhibited in an inter-disciplinary subject like Geography, where integration of progressively developed concepts, incorporation of field experiences and data, and integration of location-specific applications of learned concepts lead to a holistic understanding of an otherwise potentially segregated geographic processes (Chatterjea, 2008).

The teaching of geography in the twenty-first century should teach and at the same time let the student discover, the world we live in. Focusing on globalization, global climate change, environment and society/nature relations. And it should as well lead learners to interpret texts, photos, maps, and landscapes. In this sense, is concept mapping an important strategy in a geography classroom? We stated the following hypotheses: a) The use of concept mapping can contribute to teaching and learning in geography and b) It is possible to analyze with quality the concept maps created by students in the classroom.

2 Search for Papers

The search occurred in databases, journals, and conferences between 2004 and 2016. Were found twelve full papers that involve geography and concept mapping. In table 1 we can see these papers with more details.

Authors	Year	Country	Area	Level of Education	Methodologies
Rebich & Gautier	2005	USA	Global Climate Change	Higher Education	17 undergraduates; pre- and post-course (concept maps); quantitative.
Chatterjea	2008	Singapore	Physical Geography	Higher Education	22 students; concept maps; qualitative.
Wehry et al.	2010	USA	Human Geography	Middle School	43 students; selected-and-fill-in concept maps; quantitative.
Akbaş & Gençtürk	2011	Turkey	Air Pressure	High School	90 students; control group (n=45) and experimental group (n=45); concept maps was used to teach one group; quantitative.
Monroe-Ossi et al.	2012	USA	Human Geography	Middle School	6 th grade (don't know how many students); conceptual card game and concept maps; qualitative.
Ratinen et al.	2012	Finland	Climate Change	Higher Education	20 undergraduates; essay writing and drawings; pre- and post-course (concept maps – was created by researchers); qualitative (case study)
Reitano & Green	2012	Australia	Teaching Geography	Higher Education	6 teachers; pre- and post-course (concept maps); qualitative (case study).
Amador et al.	2012	Portugal	Geology	High School	High school (don't know how many students); concept maps; qualitative (content analysis).
Salvi et al.	2014	Brazil	Demography	High School	High school (don't know how many students); concept maps; qualitative.
Sellmann et al.	2015	Germany	Climate Change	High School	95 students (control group=29, experimental group=66); pre- and post-program (concept maps); quantitative and qualitative.
Campelo & Piconez	2016	Brazil	Seasons	High School	40 students; concept maps (in two stages); qualitative.
Okafor	2016	Nigeria	Geography	High School	225 students; (experimental group I=78, II=74 and control group=73); concept maps (only in group I); quantitative.

Table 1: Papers about concept mapping and geography

We found papers from America (5), Europe (4), Africa (1), Asia (1), and Oceania (1), showing the expansion of concept mapping over the world in geography. The CMC occurs in two and two years, one in America and another in Europe, maybe it can explain better why we have more full papers in these continents. In 2017, Asia held a

specific conference about concept mapping, in future we can see more papers about geography in this continent. Table 1 shows that concept mapping has been studied since middle school to higher education like others areas.

3 Research Methods

The objective of this study is to analyze and describe the uses and possibilities of concept map in geography teaching. To this end, in order to establish groups and methods of use, all the full papers found were read and analyzed, the focus was on the purpose of the papers, the methodologies and the results.

A search was conducted on variety databases including Periódicos Capes and BDTD (Brazilian bases); Scielo, Dialnet, WorldWideScience, ERIC, and Google Scholar. Also, a search was done in journals including Journal of Geography, The Journal of Educational Research, Journal of Education and Practice, Journal of Geoscience Education, International Journal of Multiple Research Approaches. To finish, the search continues in the Proceedings of CMC and others International Conferences.

The key terms used in the search was “concept map”, “concept mapping”, “geography”, and “geography teaching”. In the data collection phase, were found twelve full papers that involve geography and concept mapping.

After the analysis, three groups were created: qualitative analysis, quantitative analysis, and qualitative/quantitative analysis. In the group of qualitative we have seven full papers (Chatterjea, 2008; Ratinen, Viiri and Lehesvuori, 2012; Monroe-Ossi et al., 2012; Reitano & Green, 2012; Amador et al., 2012; Salvi et al., 2014; Campelo & Piconez, 2016). Another group, quantitative, we have four papers (Rebich & Gautier, 2005; Wehry et al., 2010; Akbaş & Gençtürk, 2011; Okafor, 2016). Sellmann et al. 2015 is a full paper that involve both qualitative and quantitative analysis.

4 Analysis of Studies using Concept Maps in Geography

All twelve full papers were analyzed, the focus was on the purpose of the papers, the methodologies and the results. We can see a summary of this papers.

4.1 Qualitative Analysis

Chatterjea (2008) emphasizes Geography as a discipline that covers several areas of knowledge to study the environment on planet Earth and uses concept maps to integrate diverse concepts from different areas. Two disciplines of two higher geography courses were analyzed: Biogeography and Management, according to the researcher are disciplines that use diverse concepts from other areas, such as Biology, Geomorphology and Hydrology. The main objective of the research was to use the concept mapping techniques to facilitate a holistic and interdisciplinary understanding of the concepts. He proposed an activity that is based on the knowledge acquired through the classroom, laboratory experiments and field research.

At the end of this activity, students were expected to integrate knowledge previously acquired from previous concepts and other concepts related to Geography. They should develop concept maps using CmapTools, with appropriate nodes and links, which indicate their ability to integrate concepts into a holistic understanding of the environment and interrelated links. The results of the research were positive and pointed out that the use of CmapTools was important to elaborate the connectivity of several concepts and proved useful to integrate the previous knowledge to the foreground.

Ratinen, Viiri and Lehesvuori (2012) investigates 20 teachers in science education, who underwent training on climate change. The present study examines a series of four science sessions given to a group of primary school student teachers. This include analysis of communication styles used and the students’ pre- and post-conceptualization of climate change based on results obtained via essay writing and drawing. Concept mapping was used in the analysis of the students’ responses. The objective of the study is to consider how these future teachers understand the climatic changes after the expositive classes.

The results suggest that there were no conceptual changes in teachers' knowledge about climate change, even after sessions by university professors. No doubt their knowledge has improved, but they are still incomplete. The authors cite other studies that show similar results and believe that climate change is a complex subject to be understood in a short space of time. Ratinen, Viiri and Lehesvuori (2012) also consider that students participated very little in the classroom discussions, felt more confident and participated more only in the last session that was geography, this may have affected students' progress in the course. The low participation of the students, according to the researchers is related to the fact that they do not dominate the concepts.

In other study, Monroe-Ossi et al. (2012) described and discussed the concept mapping strategies used to review and assess 6th grade middle school students' knowledge of a human geography curriculum. The students were participants in an after-school college reach-out program (CROP) first implemented with 6th graders during the 2007-2008 academic year. The conceptual Card Game was adapted and was used with students.

Discussion of the concept mapping activities focuses on the use of a game to motivate CROP participants to fully engage in a review of the impact of their friends and families on their self-concept. From the perspective of the game cycle, students expressed interest in the game and most indicated that they thought the game was exciting, fun, and challenging. The recorded lessons revealed that interest increased over time as indicated by student engagement, which lead to feedback from the game. The authors believe that the card game was successful in activating students' thinking about how their friends and families influence self-concept.

Reitano & Green (2012) did a case study of six preservice teachers who studied a 10-week unit of secondary geography in their 4th (and final) year of education studies. The focus of research was track participants' conceptions of effective geography teaching, over a period of time; that is, to provide an example of conceptual change. Participants constructed concept maps at the beginning and at the end of their geography curriculum methods course.

The results were good. Comparing the two sets of concept maps, the researchers in this study were able to gain an insight into geographical knowledge growth and conceptual change over the duration of the methods course. Concept mapping proved to be an appropriate tool to develop curriculum literacy for intending teachers, but it also indicates that they are developing a literacy specific to teaching school students.

Amador et al. (2012) intended to examine the perceptions of a sample of Portuguese pre-university students on natural hazards, using to this end the concept maps developed by them. The results show that concept mapping can be an important technique in the analysis of students' perceptions about thematic complex and transdisciplinary thematic such as natural hazards. It was found that there are different results for students from 10th to 11th grade who attend the discipline of Biology-Geology. Students of the 10th grade made use of a larger number of external concepts and provide more frequently combinatory links. In the other hand, students of 11th grade expressed more structured and hierarchical knowledge. The results allowed to reflect on the best way to teach certain topics, particularly natural hazards.

The paper by Salvi, Tomita and Neto (2014) was a qualitative research and used the concept maps to work the concept of population. In an attempt to overcome a fragmented view of Geography and the relationships between the studied content and the basis of the organization of space, was proposed the application of activity using concept maps through a project in a school with students of high school.

It was noticed that the content "Population" and the construction of concept map motivated the participation of the students who saw the development of this content by the interdisciplinary bias involving History, Mathematics, Sociology and other disciplines. Students were made easy to bring content to their daily lives and to look for example and turn them into geographical concepts.

The students received a list with diverse concepts about population and tried to connect these with the current reality and started from a colloquial language to elaborate scientific concepts. The study was motivated by a proposal for the teaching of Geography with an emphasis on interpretation and understanding rather than on the memorization and recitation of geographical content. As a result of concept maps created by students, it was apparent that most of them mastered the tool of concept mapping and discovered the usefulness and advantage of studying Geography.

Campelo and Piconez (2016) investigated the extent to which concept maps can foster meaningful learning in high school students. Forty geography students participated in the study. The students made a concept map during the second stage of the research and these maps were compared with other semi-structured ones made during the fourth stage. For the analysis of these concept maps, the methodology of Hay (2007) was used to understand the type of learning that occurred with the students. Nowadays, student testing with the purpose of memorizing content - mechanical learning - continues to prevail in schools in Brazil. Using concept maps in High School can contribute to a change in the learning of our students. The results showed that students need more time to practice the concept mapping technique, despite the fact that progress was observed during the making process of concept mapping.

4.2 *Quantitative Analysis*

Rebich and Gautier (2005) used concept mapping as a tool to reveal (pre)existing knowledge and to monitor conceptual change arising during participation in a college course on climate change policy. They analyzed concept maps by classifying concepts and links with regard to an expert map; their results indicated that participation in their course might have triggered conceptual change. However, due to the quite time-consuming and complex analysis, this analysis or similar approaches may be impracticable in school life.

In the 4th CMC, the article by Wehry, Monroe-Ossi, England & Fountain (2010) proposed assessing the knowledge of middle school students of human geography who participated in an "after school" program. The purpose of the program was to motivate students in the subject. There were 43 participants, composed of 29 girls and 14 boys. They used the select-and-fill-in (SAFI) approach. Researchers developed concept maps and used the key concepts studied on middle school students. They presented concept maps by removing some concepts and phrases of connection, for students to fill in properly. The results showed that students had got confused due to the teaching approach and methodology in the lesson. The authors concluded that concept maps were important for evaluating the acquisition of knowledge of human geography. However, it is still necessary for the curriculum to be review because it is still not clear for the students, despite the fact that most students achieved good results by completing concept maps of the three years of teaching they surveyed.

Researchers developed concept maps, such as geography specialist support, used the key concepts studied with middle school students. They presented concept maps by removing some concepts and phrases of connection, so students should fill in these concept maps correctly. The results of the research show that the methodology is considered by the researchers as very important to evaluate the knowledge about human geography, but they point out that the curriculum needs to be review in some points, because the students were confused. However, most students achieved good results by completing the concept maps.

As stated by Akbaş and Gençtürk (2011) a study was developed in which they used concept maps to identify misconceptions high school students had regarding the topic of "Air Pressure". A control group was taught with a teacher-center approach in comparison to a student-center approach in which concept maps were used as a tool to deal with misconceptions. Two separate tests were used for data collecting; a success test, to define students' knowledge level about concepts and discover their misconceptions, and a concept test, to define the level of students' misconceptions before and after the study, were employed as a pre-test and post-test involving multiple choice questions. In the pre-test, no difference was observed in the results of the two groups. In the post-test, the research results showed that educational methods based on the use of concept change texts combined with concept mapping are more efficient than traditional teaching methods.

The authors concluded that concept maps are helpful to identify learners' misconceptions that happen during the learning process. By diagnosing their misconceptions, it was possible to clarify specific doubts before introducing a new topic. They argued that without making clear these misconceptions, scientific knowledge is very difficult to be learned as students take for granted that what they believe are the "correct" facts and concepts.

Okafor (2016) analyzed Nigerian high school students from different groups. A sample of 225 students were defined in an attempt to understand the problems that affected the performance of students in national geography exams. According to the author, two points were raised: geography has a very wide content and teachers have used ineffective methodologies in lessons. The researcher developed a quasi-experimental study of a non-equivalent control group. The author argued that it was not possible to have complete randomization of the participants. Intact

classes were used. The study was quasi-experimental because the researcher manipulated the independent variables of the study, which were concept mapping and outlined note-taking patterns and observed their effects on achievement.

The intact classes randomly assigned to experimental and control groups were used. Three groups were created to test the author's hypothesis. The first was experimental group one, which was taught with concept mapping notes. The second was experimental group two, which was taught with outline notes. The third was the control group and it was taught with conventional notes. At the end of the lessons, students were assessed through a national TOGAR (Test of Geography Achievement and Retention) exam. The results showed that the students of experimental group one, who learned geography with the support of the concept maps, obtained better results than the other two groups.

4.3 Qualitative and Quantitative Analysis

In order to analyze the conceptual changes of the students, Sellmann, Leifländer and Bogner (2015) propose a more viable way to analyze the concept maps of the students. They cite other studies that evaluate the concept maps of the students but believe that these analyses are not feasible for the daily routine of a teacher. This methodology to analyze the concept maps involves qualitative and quantitative analysis.

The results pointed out that the students who participated in control group, did not have conceptual changes on the subject studied climate change. Already the students who participated in the project, their concept maps showed considerable changes of concepts related to the studied subject. For the researchers the method they used is possible to apply in the day to day of a teacher, since it does not imply a great mechanical work. As a limitation of the study the small number of students that were analyzed, a larger sample would be necessary.

5 Conclusion, Limitation and Future work

The main conclusions drawn from this paper is that the concept maps are a powerful tool for teaching and learning Geography at any level of education. There were many advantages of using concept maps that possibility the teacher discovers the prior knowledge of the student and identify their cognitive advancement on a particular subject studied.

The use of concept mapping can contribute to teaching and learning in geography. It was the first hypothesis and it can be confirmed. The literature review highlights a variety of ways to show how is concept mapping in the classroom, the results are always positive when students work with concept maps to learn concepts about geography.

It is possible to analyze with quality the concept maps created by students in the classroom. It was the second hypothesis and it cannot be confirmed. Sellmann, Leifländer and Bogner (2015) presented a way to analyze the concept maps created by the students in the day life of a teacher, but it was a small study. Others studies, for instance, Rebich and Gautier (2005), Chatterjea (2008), Akbaş and Gençtürk (2011), and Okafor (2016), showed methodologies that took a lot of time to analyze the concept maps created by the students. This is an important topic to deepen, certainly, in future more study need to be done to solve this problem.

Concept mapping is very important to university student (future teachers). The results showed that a university student in geography can understand better the complex concept. University professors who use concept maps in their classes and researchers identify misconceptions from his students and can form better teachers. Besides that, the future teachers will be prepared to work with concept mapping strategy.

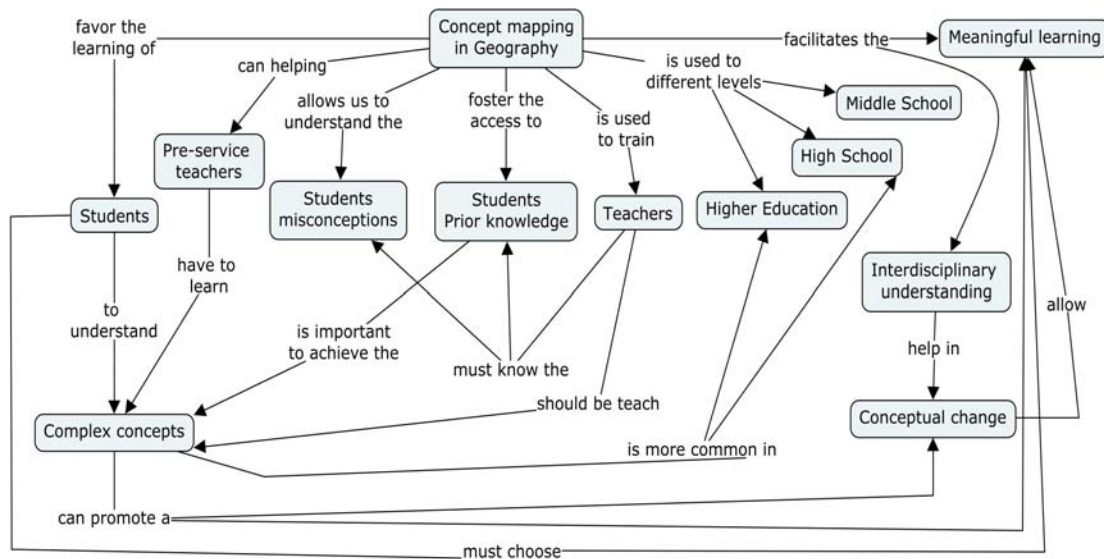


Figure 1. Concept mapping in Geography

In the concept map above (Fig. 1) we can observe what these full papers analyzed about concept mapping in geography.

Nowadays it is very difficult cover all journals, databases and publications over the world, probably we cannot fold all full papers about concept mapping and geography, it can be a limitation in this study. Nevertheless, in the future a similar study with a larger number of papers would be beneficial to confirm the findings.

The social sciences, like Geography, will be very important in the nearby future. We have to find a collective intelligence (Lévy, 2015). With the democratization of big data analysis, the next generations will see the advent of a new scientific revolution, but this time it will be in the humanities and social sciences, and the concept mapping can be an important tool.

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