The Constructivist teaching and the optimization of learning through cognitive maps

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Abstract

This study analyzes the optimization of the cognitive map, as knowledge and understanding tool that complies with constructivist paradigm. The experiment carried out on a group of subjects, formed of students – future teachers within the University of Craiova has shown the advantages and disadvantages of the cognitive map in studying some of the subjects enclosed in the curriculum plan of the teaching training module.

The results obtained by the students of the experimental group confirmed the research objectives and hypotheses. We succeeded in demonstrating the fact that using this tool in the activities developed with students contributes to the optimization of their school results. As well, it has also been confirmed the connection between the optimization of activities in pairs or small groups, based on collaboration, in a faster understanding of concepts of scientific contents and in solving some misunderstandings that the students had related to these contents. The results obtained lead at the same time to new perspectives in studying this subject related to academic learning.

1. Introduction

Within the educational theory and practice, the constructivist theory imposes itself as a valid alternative, able to solve the mystery of the “black box”, to identify the cognitive mechanisms which lay the foundation of understanding and learning, and in the same time to overcome the supremacy of the behaviourists, who lay stress on behaviours, results and learning activity products, and less on the “way” which leads to these deeds. The new paradigm brings along fundamental changes to the level of all curricular components and all variables of the
teaching situation: finalities, contents, teaching strategies, evaluation strategies, at the relationship teacher-student level, of the roles and responsibilities that fall on them. The constructivism focuses on the student’s role within the teaching activity, of his own action of “deconstruction” and construction of knowledge (DeVries, 2003; Danforth, Smith, 2005; DeVries, Zan, 2005, Diallo, 2005), in an own manner and rhythm, but also a multiplication and diversification of the teacher’s roles (Joţa, 2006; 2007; 2008; 2011).

Being the result of the student’s own activity, constructivist learning focuses on understanding, making some correlations, associations, inter and transdisciplinary associations, based on a complex documentation, exploration, investigation, explanation, interpretation.

In this context, an important role is played by graphic organizers that allow the learning person to structure the information, essentialize and establish the connections, relations among concepts, sub-themes, characteristics, etc. Among graphic organizers, cognitive map (known under the name of “mental mapping” or “concept mapping”) is highly used in constructivist teaching. As imposed in theory and educational practice by Novak in the ’70, which, based on the psychology of Ausubel’s learning theory, tried to explain the forming of concepts during childhood (Novak, Cañas, 2007), this tool has known multiple modifications and improvements along the time.

Various authors (Lanzing, 1996; Joţa, 2006; Novak, Cañas, 2008, Cañas, Novak, 2012) indicate characteristic aspects of the cognitive map: a) Existence of similarities between the structure and functionality of neurobiological and cognitive networks from psychology of learning and the pattern of cognitive maps, respectively of informational “nodes” that can be detailed, diversified; b) The purpose of drawing up a cognitive map can be: production of ideas, solutions, versions, etc; projection of a complex structure (text, theme) or communication of ideas of higher complexity; supporting learning, by achieving some connections between old and new knowledge; evaluation of the way of understanding a theme, problem, identification of misunderstandings; c) Allows the knowledge of the content of a concept, a theme, of the relationships, connections that exist between sub-concepts, sub-divisions; d) Involves a hierarchic structure of concepts, starting with the main concept, to the “nodes” of the map, then to derivative concepts; an important role fall on cross-links, which favor understanding, purchasing power, association, correlation; e) Representation of nodes and relationships among them knows a graphic diversity, materialized in marking logical reports between terms, the distance between central and derived terms, in the order of covering the steps of structuring and “reading” the map, in the possibilities of plastic pointing some significations and relations.

There is a varied typology of cognitive maps (Joţa, 2006); hierarchic (under the form of the parse tree, circular, in cluster, under the form of “spider web”, column disposal (from left to right), multiple colored or through various graphic signs, etc.

Drawing up some cognitive maps encloses the covering of some stages (Mogonea, 2005, page 207; Mogonea, 2011, page 201): Full reading of text, theme, chapter, etc; Its understanding, concentration, essentiality, under the form of some key words (10-15); Graphic organization of concepts, starting from the central one, and continuing with those derived from it (which represents the map “nodes”), then with a third chain of words/concepts etc, depending on the respective theme; Graphic marking of relations (of subordination, equivalence, reciprocity) that exist among the represented concepts; Completion, correction, map finalization, eliminating useless information.

Many studies (Markow, Lonning, 1998; Kinchin, 2000a; 2000b) insist on positive effects of the cognitive map, seen as an advanced graphic organizer which supports learning and understanding (see figure 1).

Other authors underline the role of the cognitive map in evaluation, others, on the contrary, consider that we must not forget the role of the cognitive map to the evaluation one (Cañas, Novak, 2012). Beyond the recognition or not related to the efficiency of cognitive map as evaluation tool, we must admit the fact that it helps discovering students’ wrong conceptions (McClure, Sonak, Suen; Roberts, apud Safayeni, Derbentseva Cañas, 2005).
2. Research design and methodology

The research – action developed during the university year 2011-2012 resumes the older preoccupations concerning the use of graphic organizers, especially of cognitive maps, within a Grant research project, developed during 2005-2007.

Purpose and Objectives of Research. The purpose of our research consisted in the identification of the efficiency of cognitive maps in academic learning, respectively in training the future teachers, in general context of using some models, methods and tools that are specific to constructivist paradigm, of the application and compliance with the principles of this paradigm in psycho-pedagogical training and teaching. Objectives of the research: a) Identification of the understanding level of some themes, specialty texts of students that will be the future teachers; b) Knowing the working style, of intellectual work, of learning techniques used; c) Establishing the connection between using cognitive maps and improving the results of students in studying pedagogy.

Hypotheses In the demarche of research, we have started from the following general hypothesis: The use of cognitive maps, as means of graphic organization of knowledge, facilitates the understanding of the problems of psycho-pedagogical subject and efficiency of learning. Derivates from general hypothesis, particular hypotheses aimed to: a) Draw-up cognitive maps both on pairs or small group, through an activity based on collaboration, it will determine the speeding up of the learning process; b) By using cognitive maps in learning pedagogy by the students – future teachers, they will be able to identify and eliminate more easily any misunderstandings, confusions, mistakes.

Sample group and content. The sample group was formed of 204 students – future teachers, from several faculties (Letters, Economy and Business Administration and Horticulture) within the University of Craiova. Being a pedagogical research of improving type, we used two types of groups: experimental (80 students) and control (witness) (124 students). The content sample was formed of themes of some of the subjects enclosed in the Curriculum Plan of the Programme regarding the certification of competences for teaching profession. (Pedagogy I, Pedagogy II, Classroom Management).

Methods of Research Used. In order to valorize the hypotheses and attaining the purpose and objectives of the research, we used the following methods and research tools: systematic observation (through grilles or observation protocols); enquiry based on questionnaire; knowledge pedagogical test; psycho-pedagogical experiment, and in order to interpret the results, we used mathematical-statistical methods and methods of their graphic representation. Within the experiment, we aimed at observing the following correlations: a) between using cognitive maps and efficiency of learning; b) between improvement of the activity based on collaboration and easing the understanding of the problems discussed or that had been approached; c) between using cognitive maps and a faster understanding by students, of the difficulties that they encounter in understanding the themes. All along the experimental phase, we
used the cognitive map, in order to understand, systematize, order, schematize knowledge that are specific to subjects Pedagogy and Class Management, that had been covered by the students that will become the future teachers.

3. Results

The tests applied before and after the experiment where there had been introduced independent variables, allowed the achievement of some comparisons between the results registered by students in the two different moments that are presented in table 1.

Table 1. Results obtained by students to tests applied

<table>
<thead>
<tr>
<th>Sample Group</th>
<th>Stage of Research</th>
<th>Pretest</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>7.41</td>
<td>7.32</td>
<td></td>
</tr>
<tr>
<td>Experimental Group</td>
<td>7.23</td>
<td>8.02</td>
<td></td>
</tr>
</tbody>
</table>

The results that had been registered by the experimental group, to which had been made the formative intervention, in comparison with the control group, had shown the efficiency of acting means and tools proposed in the students’ learning activity.

In order to confirm the hypotheses of the research, we have made comparisons both between the samples (by comparing the results recorded by the two samples in the post-test stage), and inside the samples (by comparing the results recorded by the experimental sample in the pre-test and post-test stage; the formative intervention being held between the two moments of recording).

As it can be seen from table 1, the average of the experimental sample at the applied tests was better in the post-test stage in comparison with the pre-test stage. Withal, the results recorded by the experimental sample in the post-test were better in comparison with those of the control sample. In order to mark the statistical relevance of these differences, we applied Z test for large sample groups (N>30) (see table 2 and table 3).

Table 2. The results recorded by the two samples in the post-test stage

<table>
<thead>
<tr>
<th>Sample of subjects</th>
<th>Average</th>
<th>Standard deviation</th>
<th>N</th>
<th>Value of Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>8.02</td>
<td>2.11</td>
<td>80</td>
<td>3.5</td>
</tr>
<tr>
<td>Control</td>
<td>7.32</td>
<td>2.23</td>
<td>124</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 The comparative results pre-test – post-test of the experimental sample

<table>
<thead>
<tr>
<th>The stage of the research</th>
<th>Average</th>
<th>Standard deviation</th>
<th>N</th>
<th>Value of Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>7.23</td>
<td>2.14</td>
<td>80</td>
<td>3.43</td>
</tr>
<tr>
<td>Post-test</td>
<td>8.02</td>
<td>2.32</td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

The values of Z, relevant at a significance threshold of 0.1, prove the validity of the hypotheses and the efficiency of the actionable-methodological means used. In comparison with the control group, the experimental one recorded better results due to the psycho-pedagogical formative intervention.

The use of cognitive map in a small group (3-5 students) proved to be efficient in understanding the problems of the theme proposed, the members of the group having the possibility to correlate and correct their own opinions with those of the others, to learn from and/or together with the others. We were able to establish a connection between the activity based on collaboration and facilitating the understanding of the themes approached. Only in the situation that the cognitive map was used as evaluation tool, the activity based on collaboration did not prove to be efficient. The attempt to synthesize, structure, essentialize, schematize a scientific content allowed pointing out some mistakes, misunderstandings, preconceptions of students. Confronting with the opinion of group colleagues, then with those of a larger group and, subsequently, with the teacher’s opinion, determined the correction of many of these mistakes.
4. Conclusions

This study aimed at pointing out the efficiency of the cognitive map, as a cognitive-constructivist and social constructivist learning tool, which valorizes both independent activity, and the activity based on collaboration. The results registered by the students of the experimental group improved after the formative demarche they had been involved in, the difference of the results from post-test in comparison with the pre-test being significant from the statistical point of view.

The results confirm not only the hypotheses established, but also some ideas, existing theses in specialty literature regarding the advantages and disadvantages of using the cognitive map (Cañas, Novak, 2012). At the same time they offer the possibility of framing some new aspects, that can be approached in future researches. Some of them can be related to thoroughly studying the efficiency of individual activity, in comparison with the activity based on collaboration in drawing-up these maps. As well, we consider that we can very carefully follow the role of this tool in evaluating students.

References


