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Investigating the impact of Concept Mapping Software on Greek students with Attention Deficit (AD)

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ABSTRACT

The present study investigates if there is a positive effect of the use of concept mapping software on students with Attention Deficit (AD) when learning descriptive writing in the secondary level of education. It also examines what kind of difficulties AD students may have come across during this learning procedure. Sample students were selected and assessed in their use of a combination of distinct educational tools, namely a questionnaire for teachers following the Greek Evaluation Scale (ADHD), the Stroop Test and the Trail Making Test. The students involved in this case study learned by implementing computer-based tools and then answered a number of questions regarding the perceived benefits of technology, accomplishing, in this way, the main purpose of this paper. Results arisen in this case study confirmed that the majority of the students believe they learn better when using computers and that particularly the concept mapping software presents the subject matter in an easier, more interesting and pleasant way, despite some difficulties throughout the learning procedure.

Keywords: *Attention Deficit, ICT, Concept Map, descriptive writing, case study, secondary education*

INTRODUCTION

The term *Information and Communication Technology* (ICT) has become increasingly prevalent in discourse about schools and teaching during the last decades. The low cost and wider computer software available facilitates the spread of computer-assisted teaching in education since the successful integration of ICTs into learning environments has the potential to benefit all students as well as students with special educational needs and particularly with attention deficit.

Indeed, some students have difficulty focusing their attention, organizing and integrating thoughts and ideas while writing. Concept mapping software allows for visual representation of ideas and concepts. These representations are presented in a physical manner and can be connected with arrows to show the relationship between ideas. These graphically represented ideas can be linked, rearranged, color coded, and matched with a variety of icons to suit the need of the user.

One puzzling question is the effective impact of these technologies on students' performance and on their positive or negative perception. Many researchers have tried to answer this question but they have faced two main difficulties. On the one hand, students' performance is hard to observe and there is still confusion about its definition. On the other hand, ICT is evolving technologies and their effects are difficult to measure due to the diverse students' technological background.

What is lacking, however, is further empirical data to support or refute these theoretical claims with respect to special education. Teachers (and researchers) need to evaluate concept mapping

activities from an educational perspective so as to determine whether they can be embedded into their teaching practices effectively. These aims of examining the educational impact of ICT activities and measuring students' views on ICT lie at the center of the work presented here.

THEORETICAL FRAMEWORK

According to the information processing theory, attention plays a vital role in both the conception of a stimulus and its transfer to memory (Korkman & Pesonen, 1994). More analytically, the stimulus is conceived by the receptors of the sensor organs and is transferred to the short-term memory. After a very short period of time, it will be either transferred to the long term memory for further encoding or even storing or it will be discarded from the cognitive system (Atkinson & Siffrin, 1968). Consequently, attention and memory interact and they both have effective implications on the learning procedure at school (Hayes, 1996).

The students with attention deficit develop with delay and to a lower degree in relation to the general typical population, their ability to focus their attention on their cognitive task while at the same time ignore symptomatically secondary and irrelevant stimuli (selective attention) (Conte, 1998). So, these students have a difficulty in focusing their interest on the text they are dealing with or the information they are hearing. As a result, the information they acquire cannot be adequately transferred to the memory for further processing, something which prevents them from having a complete comprehension of the topic (Padeliadou, 2004).

According to researchers, the cognitive functions of memory, of attention and of concentration play an important role in the development of both language functions and language understanding (Korkman & Pesonen, 1994). They, also, support the idea that a child with attention deficit faces difficulties in language development, presents a low performance in composing stories or other writing assignments (Cantwell, 1996; Redmond, 2004; Mathers, 2006) and may face difficulties in both the organization and the comprehension of text information (Zentall, Hall & Lee, 1998).

Skilled teachers use special instructional tools to modify the teaching procedure and accommodate the special needs of their students with attention deficit. To accomplish that, they take advantage of multi-sensory methods as it has been proven that they provoke and sustain student's attention and enhance their performance. These methods mainly concern the use of teaching tools which engage more of the students' senses during the learning task, which allows them to enrich process and construct their knowledge. Such a constructive teaching tool is the Concept Mapping Software which facilitates creative work and assists students with learning difficulties in improving their paragraph content and their organization of structure in writing (Zavlanos, 2003; Schumaker & Deshler, 2003).

Concept mapping represents one method of classifying and representing information that aids students organize information through the use of visual aids. A concept map is a schema that represents the relationship among concepts. While using concept mapping strategies, the learners try to access their background knowledge by sorting them in classified ordination.T his process helps the learner to retrieve memorized knowledge while at the same time aims at constructing knowledge through the students' increased commitment to the learning task (Beyerbach & Smith, 1990; Jonassen, 2000; Chang, Sung, & Chen, 2002; Conradty & Bogner, 2012; Erdogan, 2009; Igwebuike, 2012; Novak, 1990; Novak, Bob Gowin, & Johansen, 1983; Tripto, Assaraf, & Amit, 2013; Tzeng, 2010; Yen, Lee, & Chen, 2012). Also, concept maps make the learning object simpler, by highlighting the subtopics of the learning object as well as the connections amongst them and thus they have a positive effect on the whole procedure of learning which becomes more exciting and interesting (Richards, 2008). Furthermore, the incorporation of pictures or digital videos in the Concept Mapping Software can, indeed, reinforce

visual memory; it can contribute to the management of complicated information and facilitate the conception of ideas for the development of narrative or descriptive texts (Hatzisavidis, Kotopoulos & Anagnostopoulou, 2008).

In the light of research and the so far experience gained from the field of learning difficulties, it is urgent for teachers to enhance the creative writing approach which refers to the students' support by the teacher, the cooperation with his/her classmates, the use of the Concept Mapping Software and the enrichment of the students' ideas before their writing. Through this process, the meta-cognition skill is enhanced and, in turn, helps students to significantly improve the quality of their writing, increase their motives and acquire competence (Tzouriadou, 2008). Moreover, the development of a positive attitude towards computers is vital for students in order to develop language learning skills (Lewis & Atzert, 2000). Attitudes require special consideration because students who feel less comfortable are more resistant to learning. On the other hand, positive attitudes, characterized by willingness and enthusiasm, help students acquire computer skills and enhance their language performance.

Monitoring teachers' and students' attitudes is significant for communal usage, acceptance and success (Woodrow, 1991). Even more, knowing exactly how students perceive computer-based technologies is very crucial(Jamlan, 2004) before their use. According to some researchers, ICTs can stimulate, motivate and have a positive effect on students' interest in learning and particularly on students with special educational needs (Deaney, Ruthven & Hennessy, 2003). This is the case in the students' increased commitment to the learning task, in their enhanced confidence, in their interest and sense of achievement when using ICTs (Cox, 1997; Nomass, 2013). Jones and Love (2012) found that digital-based social narratives are also a way to engage students in technology while helping them work on their behavior and become more attentive when they operate the computer. Kay (2007) further asserted that ICTs that utilize a visual dimension, including digital video, photography or video conferencing are found to be engaging for students.

The main purpose of this research is to investigate whether there is a positive effect of the use of concept mappiof students with attention deficit. The present survey aims at assessing the experience, skills and computer efficacy of students, measuring their attitudes towards the use of education technology and detecting obstacles and difficulties concerning the development of constructive learning environments.

Research questions

Based on the ICT implementation in teaching writing skills and specifically that of writing descriptive essays to students with attention deficit, the questions of this research are:

a) whether the introduction and practice of concept mapping techniques can be used to raise their interest and transmit the subject matter easier and more pleasantly.
b) whether the students faced any problem during the ICT learning procedure and which these problems were.

METHODOLOGY

Our case study took place in schools of secondary level of education within the prefecture of Drama, which is a town of Macedonia, in the North-East of Greece.

Research design

This study was mostly quantitative using a survey strategy and the research was conducted using questionnaires for data collection. Sample students were selected and assessed in their use of a combination of distinct educational tools.

Questionnaire design

Initially, the teachers of these schools filled in the questionnaire (addressed to teachers) following the Greek Evaluation Scale for ADHD (Kalatzi-Azizi, Aggeli & Eustathiou, 2012). The questionnaire aimed at identifying students with attention deficit on the basis of DSM IV (Diagnostic and Statistical Manual IV, American Psychiatric Association, 2001). Kalatzi-Azizi balanced the ADHD Rating Scale-IV with the Greek reality after a suitably structured statistical survey. Afterwards, the students who had attention deficit, according to the specific Scale, participated in the color and word Stroop test (Spreen & Strauss, 1998; Gougoulias, 2008) and the visual-brain trail making test, both of which evaluate the students' ability to maintain their attention focused on the cognitive task (Arnett & Seth, 1995). In this experiment, the students are required to say the color of the word that is printed, not what the word says. Naming the color of the word takes longer and is more prone to errors than when the color of the ink matches the name of the color. The Stroop test is considered to be able to distinguish students with attention deficit disorder from the ordinary students (Sergeant, Geurts & Oosterlaan, 2002; Zalonis et al, 2009). Also, the Trail Making Test is widely used for the evaluation of attention abilities, visual-kinetic speed, information processing, cognitive flexibility and attention and inattentive thought (Spreen & Strauss, 1991; Lezak et al., 2004). There are two parts to the test: part A, in which the targets are all numbers (1,2,3, etc.) and the test taker needs to connect them in sequential order, and part B, in which the subject alternates between numbers and letters (1, A, 2, B, etc.). To protect the participants' identity, pseudonyms have been used in this research.

Participants

The participants in this study were a total of 32 students with ADHD. All of the participants were in the first grade of secondary education. They took part in this study voluntarily after an invitation by their teachers. All of the participants were at the age of 13 or 14. To ensure student equality in terms of writing performance, we included in our sample only those students whose grades in the first semester ranged between 11 and 12.

Data collection

After the students with difficulties in attention span had been identified, they were asked to answer a questionnaire which examined the following characteristics: gender, average grade of achievement, their parents' occupation, their parents' highest rank of education, the presence of a computer in their house, the chance of having access to the Internet at home, the amount of hours they used the PC per day, the basic reason they used the PC for, the use of the PC by any other family member at home and the programs they knew how to use. These data, coming from the students, were collected by the researcher so as to make sure that both male and female groups were relatively homogeneous in terms of grade of education, urban or non-urban place of living and computer skills, and also to ensure that all students were computer literate.

Then the group, consisting of 32 students (23 boys and 9 girls) at the age of 13 or 14, engaged in learning related to descriptive writing and to Greek culture, by taking advantage of ICT tools and particularly the concept mapping software, the interactive board, the computers, the word-processor and the Internet.

The students worked and collaborated in teams since they had been divided into subgroups of three or four members depending on the overall number of students with attention deficit. A short

text was presented on the interactive board and the students could also read it on their own computer screen. They were asked to answer the following exercises using the facilities of the Word Software (e.g. marking the word with the mouse and bold): 1. What kind of text is the following one? 2. Spot the adjectives used in the text. 3. Spot the verbs used and then identify their tense and find which of them are called auxiliary. 4. Which linking words are used in the text? 5. Find the topic sentence, the main part and the conclusion. 6. Which is the communicative frame of the text? 7. What is the objective of the text?

Whenever the students answered correctly, the right answer appeared in bright colors on the screen of the interactive board, according to the sequence of questions-answers. Afterwards, the concept map appeared and was filled in step by step until it was eventually completed, including the main characteristics of descriptive writing. After that, a semi-completed concept map including the following questions was shown on the screen of the interactive board, as well as on the students' PC screen:

1. Where is the town of Drama?
2. What is the town of Drama famous for?
3. What activities can somebody do in the town of Drama?
4. What are the most important monuments in the town of Drama?

Finally, the students were asked to complete on their computers, the semi-completed concept map on the basis of the information they had heard and seen in a three-minute video which had been displayed to them twice. They could fill in the specific concept map by clicking on a hyperlink on the town of Drama. This video described the town of Drama and offered all the answers to the questions of the semi-completed concept map.

During the second teaching hour, students answered a number of questions after the evaluation process. This step helped the researcher to investigate the importance of ICT in relation to the learning procedure. More specifically, the students were asked on whether:

1. the PC contributes to making the lesson a more interesting learning procedure.
2. the Concept Mapping is easy (to deal with).
3. the Concept Maps facilitated students in understanding the subject matter in a more pleasant way.
4. they prefer to work individually or in groups.
5. they had faced any problems during the learning procedure, naming them.

The students were informed that they would keep their anonymity and that there would be no way in which anyone could be able to find out who wrote the essays. The students were also told that they did not need to fill out the questionnaire if they did not want to.

FINDINGS AND DISCUSSION

With reference to the first research question of this research, it was made clear that implementing ICTs in the learning procedure positively affects students' attitudes. More specifically, as it becomes obvious in the bar chart 1, the overwhelming majority of the students (94,4%) consider that the PC does make the lesson more interesting. Also, the bar chart below clearly indicate that a noticable percentage (58,33%) of the students believes that the Concept Mapping Software which was implemented for the teaching of the subject matter is easy in comparison to the 41,67% of the students who found it difficult. the third bar shows that the overwhelming majority of the students (91,7%) have answered that Concept Maps had made the learning material more pleasantly accessible to them while only 8,3% of the students have expressed the opposite opinion. Moreover, the majority of the students have declared that they generally prefer to work in groups.

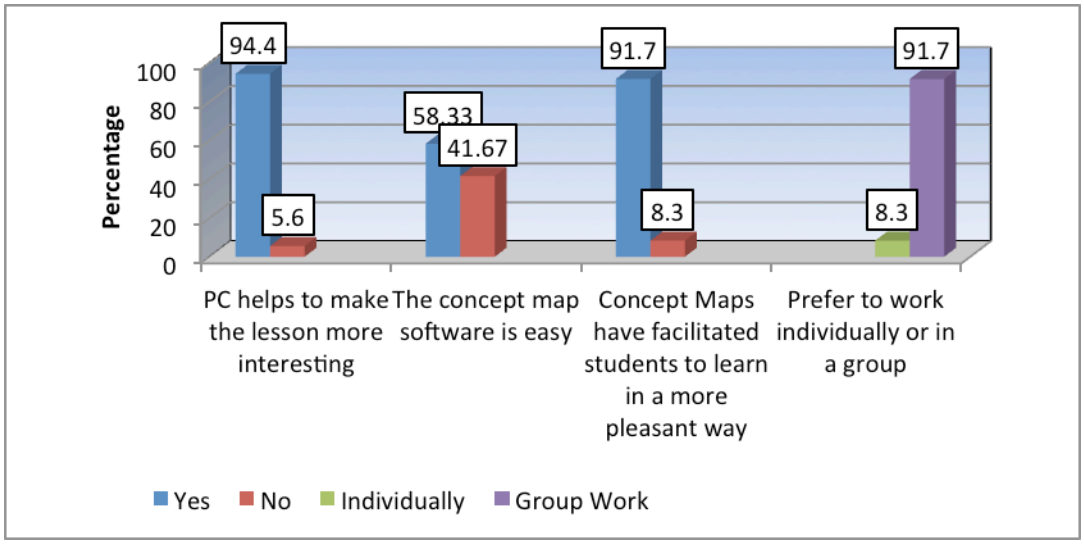

Figure 1: *The effects of the use of concept mapping software on students with attention deficit*

In order to research whether students had any difficulty during the Concept Mapping implementation, so that our second research question can be confirmed or refuted, we have conducted further statistical analysis. As far as the problems faced by the students were concerned, taking a look at the figure 2 below led to the following findings:

1) 54,55% of the students had difficulty in using the Concept Maps whereas 45,45% of them had no difficulty at all.
2) 65% of students stated that they encountered difficulties while using the Concept Maps while using the Concept Maps due to their slow PC typing.
3) A very small percentage of only 5% declared that they found it difficult to use the Concept Maps because they could not easily use the PC mouse.

Also, 55% of the students answered that their basic difficulties in relation to the general use of computers concerned the application of certain PC software.

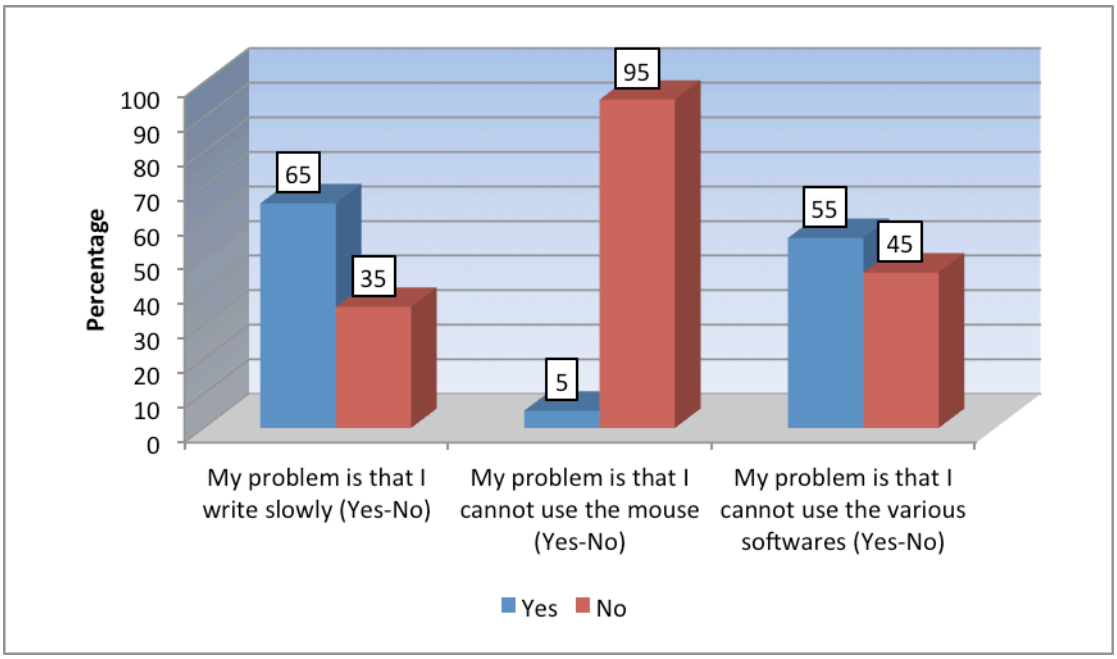

Figure 2: *The problems that AD students faced during the ICT learning procedure*

Investigating the attitudes of students towards concept mapping is important because the process of mapping is believed to have several beneficial implications (Horton et al., 2006). The analysis of the answers provided by the students through questionnaires and observation shows that the majority of the students have a very positive attitude towards the implementation of computers in class and its capability to make the lesson more interesting and vivid supporting the first research question of the current research.

Furthermore, more than half, about 60%, of the students think that the Concept Mapping software used during class is easy and that with their aid, the subject matter became not only more interesting but also more understandable in a better and easier way.

Indeed, relevant research proves that the incorporation of computers in the learning procedure helps the students with attention deficit a great deal, since they attract both their attention and interest (Xu, Reid & Steckelberg, 2002).These results are also in accordance with previous research which had suggested that the use of concept mapping software with a parallel use of multimedia, such as the video, has a significant contribution to the enhancement of students' writing skills in comparison to the traditional teaching method (Zaid, 2011). There is also evidence of improved behavior by students with attention deficit when using digital video (Reid, Burn & Parker, 2002). More specifically, students with a low level of motivation and feelings of uncertainty regarding their learning difficulties can raise their self-esteem and their concentration on task by being more actively engaged in the learning tasks (Reid, Burn & Parker, 2002; Rabiner et al., 2010; Nomass, 2013).

Also, research involving students with learning difficulties and the implementation of three teaching methods (i.e. without concept map, with hand-written concept map and finally with concept mapping software) proved that the third method has resulted into the students showing better performance (Sturm & Rankin, 2002). Okebukola and Jegede (1989) mentioned that the use of concept mapping reduces the anxiety of students who were dealing with subject matter

consideredby them to be difficult. Jegede, Alaiyemola, and Okebukola (1990) also reported similar findings, but suggested that compared to females, males displayed a more evident reduction of anxiety towards the subject matter. Chularut and DeBacker (2004) stated that the use of concept mapping improves students' self-monitoring and self-efficacy, which is an indication of the students' positive attitude towards concept mapping.

During this concept mapping process, students preferred to work in groups so as to be able to interact, transfer, and exchange opinions with other members of their group. In relation to this point, some research studies suggested that collaborative mapping can improve social communication skills and enhance learning motivation (Guvenc & Acikgoz, 2007; Hwang, Shi & Chu, 2010; Kwon & Cifuentes, 2009).

With reference to the difficulties students faced during the Concept Map lesson, arising from the second research question, the majority of the students reported that they had difficulty in making use of concept maps, while a quite high percentage of the students mentioned no difficulty at all. The largest percentage of difficulty was attributed to their slow typing that made the use of concept maps difficult for them. Finally, only a very small percentage of the students said they could not use the computer mouse adequately and, as a result, concept maps were quite a burden for them.

The ultimate goal is to have the construction of a concept map (c-map) by the students themselves. However, the initial step for the teacher is to guide the students step by step towards understanding the concept mapping software. This is considered as a very important step as according to researchers, the teacher-constructed concept map often used for practice and training in reading comprehension exercises entails a time-saving advantage over learner-constructed concept maps (Jonassen, Beissner, & Yacci, 1993).The completion of the semi-completed c-maps (what does semi-constructed mean here? Please explain) involve the students' step by step familiarization with the c-map tools. Both these strategies can be useful in class and an appropriate alternation of these two methods may contribute to meaningful learning.

Regarding the findings extracted from the students' artifacts, what was observed was that the paragraph written by the majority of the students included a topic sentence, a main part and a conclusion, which were relevant to the topic. Another feature was that the description moved from the general to the specific, whereas the transition from one idea to the other took place in certain cases on the basis of meaning and in some others with the use of linking words/phrases. Secondly, with respect to the content, it was made clear that every sentence related to the topic and the details of the main part were more sufficient, clear and concrete. Finally, as far as the language is concerned, students used appropriate and various adjectives and adverbs, they always used the present tense and more auxiliary verbs and, lastly, their general writing style was quite appropriate.

The findings of this case study make a noticeable contribution to our understanding of the importance of ICT use in teaching students with ADHD. Similarly, since the majority of students with learning disabilities face attention problems, it can be argued that such teaching interventions can be applied to a wider population of students and to wider contexts. In the specific teaching intervention we can spot cross-curricular extensions, given that certain of its activities can be implemented in other school subjects, such as Literature, Foreign Language, Geography, History and Biology.

A factor which might have slightly affected the findings could have been the dynamic and fun atmosphere of the classes which might have positively influenced the participants' mood and, as a result, their final views about the whole process.A very important limitation of this survey, however, is the restricted time during which the project had to be conducted (2 teaching hours).

This is the time allowed by the Greek Institute of Educational Politics when the main researcher applied to it for entrance permission at state schools. The national legislation should be aligned with the educational purposes of future surveys by eliminating such time restrictions.

The findings of the present research are limited because they are based on a small number of students of a specific age, who have been assessed with specific criteria regarding the learning of the Greek Language. Therefore, the results of the current study should be cautiously interpreted. Surely, additional research, focusing on a larger sample of students coming from different age groups, involving a wider range of subjects, academic activities and software tools and evaluated with different criteria, is necessary. So, further investigation is needed to verify whether the conclusions are applicable to other learning environments and populations. Such a future research may possibly confirm our findings and validate the argument that students with AD are positively stimulated by ICTs and, more specifically of the Concept Mapping Software (CM Tools) when learning writing skills in the secondary level of education.

The limited time obviously did not allow the researcher to reach the point to get students to actually write an essay. However, at the end of the ICT training, the teachers asked the students collectively how they felt about using the computer to acquire writing knowledge. During the short interview, all students answered in the affirmative when asked if they had enjoyed those programs. The teachers observed more positive behaviors, let alone a desire to engage in more writing tasks when the students worked on the computer as compared with normal classroom activities.

CONCLUSIONS

The contribution of the present research concerns the combination of a teaching proposal with the use of interactive digital teaching environments and the investigation of whether ICTs and specifically of the Concept Mapping Software (CM Tools) stimulate positively the students with ADHD when learning descriptive writing in the secondary level of education. Based on the results of this study, it is our conclusion that integrating concept maps in writing activities is beneficial for the students with ADHD as long as they present a pedagogical influence which permeates the teaching process in-depth (Kontakos, 2002). More specifically, it becomes obvious that the teaching procedure, aided by educational technology, has a psychological advantage because, in this way, it arouses students' attention and interest. On a pedagogic level, its advantage depends on the fact that it facilitates fluent learning and enriches student's experiences. In teaching terms, it combines theory with practice and achieves more easily the implementation of basic teaching principles and methods such as cooperation, self-action, self-regulation, feedback and individuality.

Ideally, our results, springing from this teaching method, will serve as touchstones to other instructors interested in implementing evolving concept maps as well as signals to researchers and teacher educators interested in developing pedagogical practices that may yield impressive learning outcomes.

To conclude, ICTs have to be considered as tools which can lead to the restructuring of knowledge into a more self-independent and effective procedure. The main goal of their integration into school curriculum is to promote new forms, and not their unilateral and simple use as tools for some school subjects, as well as to create suitable learning environments ready to make the best use of ICTs for all subjects (Kanakis, 1989˙ Kontakos, 2002). Finally, future researches should examine the extent to which educational technology can positively affect both the teaching and the learning procedure of AD students. This study might pose the question of whether the educational community should proceed with the planning of similar teaching

implementations for the subject of the New Greek Language. It could also provoke researchers' interest for similar researches abroad so as to acquire a broader and more reliable knowledge for this field and may analyze features that make computer applications work well with AD children in learning writing.

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