

Information and Communication Technologies and the impact of gender on the writing performance of students with ADHD

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Abstract. The present study investigates whether the use of ICTs improves the writing performance of students with ADHD (Attention Deficit Hyperactivity Disorder). It also examines whether gender affects performance. A number of ADHD students were selected and were assessed for their use of a combination of distinct educational tools. Divided into two separate groups, these students were simultaneously taught the same educational material. One group learned the material by using various computer-based tools, while the other group learned by using paper and pencil. Both groups were asked to write descriptive essays. The findings indicate that the group of students who used ICTs performed better in the task of essay writing than the group who did not. The statistical analysis done to assess the impact of gender on student performance revealed that the boys who used ICTs outperformed the boys who did not. There was no qualitative difference in the girl's performance, regardless whether they used or did not use ICTs. It seems that gender makes a difference in three areas: students' attitude toward computers, students' ability to use computers and students' actual use of computers.

Keywords: ICT, ADHD, students' performance, gender, descriptive essays

Introduction

During the last few decades, the latest technological advances have had a great impact on almost every aspect of contemporary life. The influx of Information and Communication Technologies in the school environment for pedagogical purposes has become a subject of investigation. Today there is an array of information and digital tools available that can assist in the process of education. ICTs can contribute to the improvement of class presentations, of children's learning through visualization techniques, and of the interaction between students and the educational material. They can also boost significantly the creation of cooperative and constructive learning environments, requiring new learning strategies. These new strategies open new opportunities and enhance learning motivation by encouraging analytic and synthetic thinking as well as metalinguistic procedures, while at the same time boosting students' self-confidence, cultivating values and improving social interaction. On another level, they initiate students in the use of tools that promote creative expression via written, oral and multi-modal language, regardless of students' racial and national origins, restricting in this way, any social injustices or inequality due to students' variations in performance, or in their learning abilities. Finally, they promote a circular, interdisciplinary and cross-curricular approach to learning and they bypass the artificial division of knowledge put forward by the traditional analytic curriculum.

Of course, the use of ICTS in the learning process does not automatically entail its improvement (Du Toit, 2015). On the contrary, in order for ICTs to bring about the expected

outcome in terms of students' learning abilities, certain cognitive and facilitating conditions must be met in advance, so that the students can make the best use of digital tools (Eady & Lockyer, 2013). Thus, research on educational procedures might play a pivotal role in foregrounding the opportunities, the capabilities and, even, the obstacles that arise by the incorporation of ICTs in the learning process; simultaneously, studies of educational techniques have to be based on appropriate scientific framework that furthers the conversation on education.

Literature review

Technological advances and innovations in teaching have stimulated researchers and educators to combine teaching and learning methods with technology. According to Nomass (2013), traditional ways of teaching language skills have significant disadvantages in comparison with teaching methods using ICTs. Firstly, traditional methods focus more on theory rather than on practice. They basically promote the mere transmission of knowledge. Little or no effort is placed on creativity or on the critique of the notions being learnt during the educational process. Secondly, traditional methods are insufficient in the area of motivation. Students are seen as mere receptors of the transmitted information; they remain passive during the entire learning period. On the contrary, having learned to use ICTs in the classroom, students can, even after class, continue to engage in reading, writing, chatting and listening to people from all over the world concerning a variety of issues (Infodev, 2015). On the Internet, they can share and seek experiences and knowledge that schools fail to supply. The third point that Nomass (2013) addresses, is efficiency. Technology-assisted language learning is generally faster; students acquire knowledge related to language in shorter periods of time. This happens because technology is at hand at times when teachers are not. Technology individualizes the students' attention span, without the limiting factor of teacher's patience and increases the range of possible learning routes. Lastly, Nomass (2013) states that education, to a large extent, continues to be teacher-centered. In contrast, the incorporation of ICTs in teaching and learning provides students with a more active role, given that they are free to proceed at their own pace and they can receive input and produce output in various ways.

According to researchers, ICTs can stimulate and motivate students, as well as have a positive effect on their interest in learning, particularly students with special educational needs (Deaney, Ruthven & Hennessy, 2003). This positive influence can be noticed particularly in the students' increased commitment to the learning task, in their enhanced confidence, and in their sense of achievement when using ICTs (Cox, 1997; Nomass, 2013). Moreover, a number of studies have already been conducted regarding gender differences in computer-related activities and their impact on the students' performance (Imhof et al., 2007). Undeniably, ICTs play a pivotal role in facilitating the education of students with learning difficulties, specifically the ones with attention deficit. Indeed, cognitive studies indicate that the use of multisensory teaching methods is the best way to engage students, sustain their attention and reduce the difficulties they face (Kelley et al., 2007).

Research suggests that the integration of computer technologies in special education classrooms can provide the support these children need in language learning (Tan & Chua, 2012). Solomonidou, Garagouni-Araiou and Zafiropoulou (2004) investigated the effects of Information and Communication Technologies (ICTs) usage on pupils with Attention Deficit Hyperactivity Disorder (ADHD) symptoms. During their investigation, nine Greek primary school pupils with ADHD symptoms and four others without such deficit worked on computers, either individually or collaboratively, once a week for a six-week period. The

pupils focused on a series of activities especially developed for the study, with educational software and ICT environments of different types and features. It was found that specific features of the educational software used by the pupils with ADHD symptoms stimulated their attention more than others did (Solomonidou, Garagouni-Araiou & Zafiropoulou, 2004). A more recent case study showed that students with ADHD enjoyed learning through the computer; they were observed to remain seated for a sustained period of time in contrast to their usual fidgety and hyperactive nature (Tan & Chua, 2012). Jones and Love (2013) found that digital-based social narratives are also a good way to engage students with technology, while helping them work on their behavior and improve their attention span when they operate the computer.

The successful implementation of ICT-based interventions while teaching students with ADHD has been proved in various contexts and while using different ICT tools. As part of a tutoring project in a reading course, an elementary school teacher was encouraged to use an iPad as an intervention strategy and the vehicle to engage a fifth grade struggling student with Attention Deficit Hyperactivity Disorder. The device not only helped the student focus his attention, but it also facilitated his becoming much more metacognitive in his reading. A comparison between his pre- and post-assessment performance showed that the student's reading skills had greatly improved within the six-week period; such an improvement may otherwise needed an entire year. The student also gained self-confidence and the sense of being in control of his learning (McClanahan, 2012). In addition, the use of a computer, in comparison with the traditional seatwork conditions in general educational settings, may also support the performance of students with ADHD in mathematics (Mautone, DuPaul & Jitendra, 2005).

The implementation of ICTs mainly concerns the use of effective tools that help students develop visual learning skills, organize and simplify the amount of information displayed, and finally construct their knowledge (Hutchins & Engels, 2005; Conklin, 2007). Such an effective tool is the concept mapping software, which enables students with learning difficulties to improve their essay content as well as its structural organization (Schumaker & Deshler, 2003; Wan, Wan & Badrul, 2008).

Concept maps rely on the theory of visual learning and grow out of the constructivist model of learning. They aim at constructing knowledge through the students' increased engagement in the learning process (Jonassen, 2000). Digital mind maps integrate photos and videos to reinforce visual memory, make information storage in memory easier, and render the learning task more pleasant and interesting (Richards, 2008). 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. They can also help students sequence the flow of writing by contributing to the management of complicated information and, thus, facilitate especially the conception of ideas for the development of narrative or descriptive texts (Wan, Wan & Badrul, 2008).

Since the use of ICTs in high school classrooms is increasing (Arend, 2004; Demb, Erickson & Hawkins-Wilding, 2004; Kay & Knaack, 2005; McVay, Snyder & Graetz, 2005; Wurst, Smarkola & Gaffney, 2008), it is important to examine whether this implementation helps the learning process and improves the performance of high school students with ADHD and whether boys and girls equally benefit from ICTs.

Computers tend to be conceptually associated with the science, mathematics and technology. Studies have repeatedly shown that in educational environments interest and achievement in these fields are linked with gender (Hawkins, 1985; Osborne et al., 2003). Various researchers have examined whether the factor of gender affects attitudes and

behavior toward computers. There is enough evidence to support the argument that males exhibit positive attitudes towards computers and therefore acquire computer-related skills more easily than females (Barak, Lipson & Lerman, 2006; Kay, 2006). A research focusing on Chinese and British students found that males were more confident about their computer skills than their female counterparts (Li & Kirkup, 2007).

A number of studies have demonstrated that computer usage is marked by gender differences; boys are shown to be more interested in technological devices, so boys use them more frequently than girls (Lockheed, Nielsen & Stone, 1983; Kadjevich, 2000). Additionally, researchers agree that there are differences between males and females concerning the way they judge their own computer skills and self-efficacy when they perform various ICT-related tasks (Broos, 2006). It has also been suggested that females hold less favorable attitudes towards computers, whereas males appear to be more motivated to learn digital skills (Durnell & Thomson, 1997; Mitra et al., 2001; Underwood, McCaffrey & Underwood, 1990; Whitley, 1997; Broos, 2006; Bebetos & Antoniou, 2009; Baser, 2013). A number of literature reviews (AAUW, 2000; Schumacher & Morahan-Martin, 2001; Barker & Aspray, 2006; Sanders, 2006; Economides & Grousopoulou, 2008; Kay, 2008) indicate that gender differences may be waning, although the technological dominance of males is still prevalent with respect to attitude, ability, and usage, particularly in higher education.

The development of a positive attitude towards computers is crucial if students are to succeed in language learning contexts (Lewis & Atzert, 2000). Student attitudes require special consideration because the students who feel less comfortable using technological tools are more resistant to learning. Garland and Noyes (2005) have pointed out that in the educational environment, student confidence leads to a more positive attitude towards computers, and in turn this enhances the learning process. On the other hand, positive attitudes, stemming from willingness and enthusiasm to use ICTs, enable students to acquire computer skills and enhance their language performance. In the context of the present study, CmapTools were used as a means to enrich the environment and increase the level of students' motivation to learn and use language.

Based on the literature review, the aim of this study was to investigate the effectiveness of ICTs regarding the improvement of performance, when students of secondary level of education, identified with Attention Deficit Disorder, were asked to write descriptive essays. This paper examines the influence of gender and ICTs on the overall performance of two different groups. It is hypothesized that gender is related to students' performance and it is expected that the male participants' performance will be improved to a greater degree, when ICT-related tasks are implemented, in comparison with the female participants' performance.

The study is unique in the sense that it investigates the use of digital concept maps for the purpose of teaching descriptive essays to students with ADHD at the high school level. At the same time, it compares the teaching results to another group of students taught by the traditional method and examines relevant gender issues. The study furthers our understanding concerning the potential of ICTs in Special Education, particularly about the benefits for children with ADHD. Specifically, it demonstrates that concept maps can be effective in promoting the acquisition of knowledge and student engagement in the learning process. In addition, it provides insight into whether the impact of ICTs on the students' writing performance differs according to gender. This research may be useful to schools that want to incorporate the use of ICT components in the classroom and to foster students' learning experience. Although most Secondary Education schools in Greece are equipped with computer labs, their use by teachers of other subjects ranges between minimum and zero on any scale (Peralta & Costa, 2007). Many teachers lack the necessary knowledge; they

are afraid of innovation; they hesitate to incorporate ICTs in the learning process and they feel uncomfortable when they are asked to assume the role of the “guide” in technological environments of learning (Peralta & Costa, 2007). Nevertheless, the results of the present research make explicit the crucial role that teachers can play in organizing language subjects according to the needs of their class; the study encourages teachers to embrace change, adopt innovation and pursue reforms in the educational system. Consequently, the Greek government might benefit from this research and devise policies that would bring ICTs into many Greek schools so that students’ learning opportunities can be improved and their educational goals can be easily achieved. Lastly, the findings of this research could help evaluate ICT’s effectiveness on students’ learning abilities and spur further research.

Research method and materials

Research axes

The present case study was conducted focusing on 3 basic axes:

1. The specification of an appropriate sample of students from the First Grade of Secondary Education. This sample should be as representative of the Greek society as possible when it presents attention deficit problems.
2. The separation of the selected students into two random subgroups, the first of which is taught the subject matter with the aid of ICTs while the second one without ICTs. The objective is to compare the performance of the two subgroups with an evaluation test concerning the knowledge gained during the lesson.
3. The investigation of possible correlations between the members’ performance of the two subgroups with the gender variable.

Research questions

Based on implementation of the ICTs when teaching writing skills and specifically descriptive essays to students with attention deficit, the research questions were:

- a) To what extent the overall performance (in language, structure, content) of the students that used specific software to write descriptive essays (IT group) was improved in comparison to the students who received tradition instruction (non-ICT group)?
- b) Did both boys and girls benefit equally by the specific ICT-based intervention?

The design of the particular intervention

This case study took place in schools of secondary level of education within the prefecture of Drama, which is a town in the district of Macedonia, in the North-Eastern region of Greece. 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), aiming to identify 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) and the visual-brain trail making test, which evaluate the students' ability to maintain their attention focused on the cognitive task (Arnett et al., 1995). 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 (Spreeen & Strauss, 1991; Lezak, et al., 2004). To protect the participants' identity, pseudonyms have been used in this research.

The participants and their learning profile

The participants in this study were a total of 66 students with ADHD, separated into two groups consisted of 32 (ICT group) and 34 (non ICT group) students respectively. 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. As far as the ICT group is concerned, it consisted of 23 boys and 9 girls, all of whom were computer literate. Regarding the composition of this sample, this is due to the fact that ADHD is about 3:1 ratio (Andreou, Agapitou & Karapetsas, 2005) more frequent in males than females.

Data collection procedures and data analysis

After the students with difficulties in attention span had been identified, they were asked to respond to a questionnaire which examined the following characteristics: gender, average grade, parents' occupation, parents' highest rank of education, presence of a computer in the 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. The data was collected from the students by the researcher, in order to ascertain that both male and female groups were relatively homogeneous in terms of level of education, urban or non-urban residence, equivalent computer use and competence, as well as to ensure that all students were computer literate.

To assess the contribution of ICTs to the learning process, the researcher separated the students into two equally numbered groups. The first group, consisting of 32 students (23 boys and 9 girls), engaged in learning related to descriptive writing and to Greek culture, by taking advantage ICT tools, particularly the concept mapping software, the interactive board, the word-processor and the Internet. The second group (the non-ICT group), consisting of 32 students (24 boys and 8 girls), was involved in exactly the same descriptive task, but used only paper and pencil. Each group was engaged for two teaching hours. The students of both groups 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.

Upon completion of the teaching procedure, the students were assessed on the basis of their ability to write a descriptive essay. The assessment task relied on the performance criteria that were included in an analytic rubric. It is well known that analytic rubrics draw lines between as well as evaluate specific textual attributes, each with its own description and scoring scale (Barone & Taylor, 2006). To put it differently, analytic rubrics facilitate both teachers and students to concentrate on each attribute separately (Kan, 2007; Barone & Taylor, 2006), and thus make the whole assessment procedure more objective (Rezaei & Lovorn, 2010) and more reliable (Jonsson & Svingby, 2007; Silvestri & Oescher, 2006). According to researchers, it is of utmost importance to choose rubrics that are suitable for the development of the children under evaluation (Watanabe & Hall-Kenyon, 2011) and that focus on the particular genre of writing (Andrade, Du & Mycek, 2010). In the current study, the researcher-teacher who taught both groups selected the performance criteria (included in

the particular analytic rubric), based on the criteria in the teacher's book concerning the subject of Greek Language for the first grade of Secondary education and on websites that teachers can easily access when creating their own rubrics. By doing so, teachers meet the particular standards they think are important for writing tasks in a specific genre (Aggelakos, Katsarou & Magana, 2008; Writer's Choice, 2008; Andreou, Riga & Papayiannis, 2013; Andreou & Riga, 2013).

CmapTools

The IHMC CmapTools program empowers users to construct, navigate, share and criticize knowledge models represented as concept maps. In other words CmapTools allows users to design and easily create concept maps to express various ideas graphically. Furthermore, CmapTools is free and it allows everyone to create concept maps using networks resources, adjust files or links to other websites. If students use CmapTools they will be able to find the concept maps created by other users and to share, or place their own concept maps at the disposal of all the users. Thus, CmapTools allows students to work collaboratively and offers the opportunity to host and share their work (Cañas & Novak, 2008).

Group A: using ICTS

A short text was presented on the screen of an interactive board for the A group; the students could also read it on their own computer screen. They were asked to answer the following questions-exercises using the facilities of the Word Software (e.g. marking the word with the mouse and making it bold): 1) "What kind of text is the following?" 2) "Spot the adjectives". 3) "Spot the verbs, 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?"

Every time 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, filled in step by step until it was eventually completed, and included the main characteristics of descriptive writing. Then a semi-completed concept map with 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 fill in on their computers the specific concept map on the basis of the information they had heard and seen in a three-minute video that was shown to them twice. They could fill in the specific concept map by clicking on a hyperlink on the town of Drama.

During the second teaching hour, students were assessed on the basis of their ability to write a descriptive essay, while the teacher provided them with a relevant survey questionnaire. The assignment asked students to describe in a paragraph, with the aid of four given pictures, the town of Kavala in such a way as to attract the readers' attention. This paragraph was written only with paper and pencil.

In this research, analytic scoring is based on an in-depth analysis of elements of writing such as organization, content, and language. Various characteristics are listed under each element, which was based on the criteria in the teacher's book concerning the subject of Greek Language for the first grade of secondary education (Aggelakos, Katsarou & Magana, 2008; Writer's Choice, 2008; Andreou, Riga & Papayiannis, 2013; Andreou & Riga, 2013).

First, the assessment criteria in terms of organization were the following: 1) The paragraph includes a topic sentence, a main part and a conclusion, which must be relevant to the topic. 2) The description begins from the general and proceeds to the specific. 3) The description of the paragraph is defined by the writer's point of view. 4) Smooth transition from one idea to the other on the basis of meaning. 5) Use of linking words/phrases for the connection of sentences.

Second, the assessment criteria referring to the content were the following: 1) The paragraph begins with an interesting title sentence, which introduces the readers to the topic of the description. 2) Every sentence relates to the topic or to the main idea. 3) The details of the main part are sufficient, clear and concrete. 4) They present the topic of the description in an adequate and understandable way.

Finally, the assessment criteria concerning language were the following: 1) Use of appropriate and various adjectives. 2) The present tense is more frequently used. 3) Use of continuous verbs. 4) Frequent use of auxiliary verbs. 5) Correct use of adverbs. 6) Appropriate writing style. The grading scale was Likert-type with 5 points: 0, 1, 2, 3, 4 and the coding used was the following: 0-inadequate, 1-below the average, 2-average, 3-adequate, 4-exceptional. The students' performance in each assessed sector was scaled to one hundred percent regardless of the number of characteristics in any particular category. A similar procedure was followed for the overall performance. The importance ascribed to each category was equal, as following:

Organization: 33.33%, Language: 33.33%, Content: 33.33%

The students' essays were evaluated by the researcher of the present study, who is a teacher of Greek literature, and who used the above criteria (based on five levels of qualitative characteristics) to assess the students' final performance in an objective way. In an attempt to achieve credibility of results, a second teacher of literature and experienced researcher also evaluated the students' essays.

Group B: using the traditional method

As with the students of group A, the students of group B were provided with the same descriptive text, but in printed form. They were asked to answer the same questions. They were given a completed concept map with the main characteristics of descriptive writing. They were handed out a task sheet with a semi-completed concept map that had the same questions.

Students were then asked to fill in the concept map based on the information they had heard twice while listening to a tape script. In the next teaching period, the students were provided with the same task sheet as group A and were assessed on their ability to write a descriptive essay. The evaluation of the task sheet was based on the same assessment criteria. The assessment results of all students' task sheets were scaled to one hundred percent and were statistically compared.

Appropriate normality tests of the two samples were initially carried out. After confirming normality, the t-test was administered to both samples mentioned above, in order to compare the students' average performance in the final evaluation procedure) in two groups of independent observations (with and without ICT) (Shirley, Stantley & Daniel, 2004). After running the t-test, a statistical analysis of the variance of multiple factors (Factorial ANOVA) was implemented in order to investigate the influence of gender on students' performance and its impact on the two independent groups A and B. The essay evaluation score is considered to be the dependent variable, whereas gender and the distinction in A and B groups are regarded as independent variables.

Results and discussion

Comparison of the overall performance of both groups based on the written essay

With reference to the first question of this research, it became clear that implementing ICTs in the learning process affects students' performance positively. More specifically, as far as the extent to which the overall students' performance was improved, the results indicated that the performance score of students who used ICTs was on the average 61.08% whereas the performance score of group B (students who did not engage with ICTs) was only 44.31%. The normality hypothesis of the average performance of the sample was tested using Kolmogorov-Smirnov and Shapiro-Wilk tests that are proven to be statistically significant, $\alpha=5\%$ ($p=0.2$ for both groups).

Study of gender influence on the students' overall performance

In order to assess whether boys and girls benefit equally from the ICTs and, thus confirm or refute the second research question, a further statistical analysis was conducted. The gender distribution of our sample was 73.06% boys and 23.94% girls. The ANOVA that was conducted showed that the influence of gender on the two groups is significant ($F=11.559$, $p<0.5$). The t-test administered to the two samples indicated that there is a significant difference in the performance of the two groups; only for boys ($p<.001$). Table 1 presents the average performance of the two genders in respect of the use (or not) of the ICT in teaching. The research results did not confirm the second research question since boys and girls did not benefit equally.

Qualitative data

The qualitative analysis concerning the students' essays revealed that the majority of the students using ICTs have written paragraphs that consisted of a topic sentence, a body and a concluding sentence, all relevant to the topic. The description moved from the general to the specific. In certain instances, the transition from one idea to another was made on the basis of meaning while in other instances on the basis of using the appropriate linking words/phrases. Secondly, with respect to the content, it became clear that every sentence was related to the topic and the details of the body were sufficient, clear and concrete. Finally, as far as the type of language is concerned, students from the ICT group used various adjectives and adverbs; they used more auxiliary verbs and the present tense consistently. Finally, their overall writing style seemed to be more appropriate.

At the end of the ICT training, the teacher asked the students collectively how they felt about using the computer to learn writing. 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. With respect to the factor of gender and its impact on the overall student performance, the qualitative analysis of the essays reveals that thanks to ICT implementation, the boys' performance showed a significant progress in all areas of essay-writing, whereas the girls' performance improved slightly.

Table 1. Average performance of boys and girls with ADHD taught with and without ICTs

	With ICTs	Without ICTs	F	P
Girls	63.62	61.11	0.339	0.739
Boys	60.78	42.45	5.545	0.000

These findings confirm the vital role that ICTs can play both in teaching and in acquiring language skills. In this case, ICTs and mainly concept mapping software helped students comprehend deductively the characteristics of descriptive speech, by offering them the opportunity through the differentiated activities (equivalent to those in schoolbooks) to approach descriptive writing via immediate experience. Technological tools also helped students to deductively draw theoretical conclusions regarding descriptive writing, when asked to concentrate on theory and analyze collaboratively the relevant text. The use of concept mapping software, as an information-handling program, as an organizing method and as a mnemonic tool, encouraged the students with attention deficit not only to write down and combine their ideas but also to develop their language skills (Wan, Wan & Badrul, 2008; Zaid, 2011).

In terms of organization and language, the descriptive essay that the students of group A wrote was much better than the essay written by the students of group B, who had been taught the same material in the traditional way. Indeed, the students who saw the video presentation and were asked to work on a semi-completed digital Cmap came up with more complex Cmaps, reinforced the content of their own essay with better ideas and wrote a more coherent and cohesive text (Andreou, Riga & Papayiannis, 2013; Kouloubaritsi, 2002). One of the greatest pedagogical added value of the digital concept mapping to the learner occurs as the learner engages in a cooperative procedure of constructing knowledge. What is more, the greatest added value to the teacher lies in the enriched representations and descriptions that students produce. In combination, collaborative concept mapping permits the classroom teacher to follow individually all students' understanding and needs by graphically representing the students' misconceptions. Additionally, the classroom teacher, through targeted interaction, urges students to defend their thinking and offer further explanations on the way in which their understanding is organized. Another great offer of this process is that it offers teachers the opportunity to create their own questioning as well as future instructional planning so as to target specific student misconceptions (Sadler, Stevens & Willingham, 2015).

The incentive that technologically-assisted learning environment provided in combination with the teacher-guided discovery method, contributed considerably to the improvement of students' writing skills and helped them develop a self-motivated learning style. Indeed, the findings indicate that by using multimedia in classroom, teachers familiarize students with the new methods of information processing and help them adjust to the classroom environment smoothly; they keep them engaged, motivated and enthusiastic about learning (Cunningham, 2003). Dias (2010) also suggested that concept maps propel students to develop autonomy and organize the knowledge they have acquired from texts; let alone, concept maps raise students' awareness so that they become capable of reading for academic purposes. These results confirm previous research, which suggested that the use of concept mapping software (accompanied by other types of multimedia, such as video)--in comparison with the traditional teaching method--contributes significantly to the enhancement of students' writing skills (Zaid, 2011).

There is also evidence that the behavior of students with ADHD improves when the teacher uses digital video (Reid, Burn & Parker, 2002). More specifically, students with a low level of motivation and feelings of inadequacy regarding their learning abilities can boost their self-esteem and enhance their concentration by being more actively engaged in the learning tasks (Reid, Burn & Parker, 2002; Pelgrum, 2002; Rabiner et al., 2010; Nomass, 2013). In fact, in multilingual Singapore, a case study approach was chosen in four elementary school-aged students diagnosed with ADHD to examine their response to the use of computer applications in learning English. The study spanned across two school terms. The students'

spelling abilities were compared using criterion-referenced tests before and after the use of established phonics computerized programs. Indeed, it has become clear that ICTs motivated students with ADHD to stay on task, thereby improving their spelling accuracies. Moreover, significant differences were observed in the students' behaviors regarding learning and attention. The teachers noticed that the ADHD students did much better when presented with activities that are novel such as computer-based learning. It was evident that the students enjoyed learning while working on the computer as they were monitored to remain attentive for a sustained period of time as opposed to their usual hyperactive nature (Tan & Chua, 2012). As Kleiman, et al. (1981) explained, computer-based activities are able to diminish external stimuli, captivating children's attention.

Therefore, our findings confirmed the first research question of our case study which concerns the effectiveness of ICTs in relation to the writing performance of students with ADHD and they are in line with other similar research studies which have reached the same conclusion. In addition, the findings demonstrated that the implementation of ICTs did not lead to an equally significant improvement in the performance of both sexes, a fact that questions the second research hypothesis of the current research. In other words, it became easily noticeable that the girls did not benefit by ICTs as much as the boys, whose performance was greatly improved. Due to the fact that ADHD is a lifelong developmental disability, estimated to affect 3-8% of the school age population, with boys outnumbering girls in 3:1 ratio (Andreou, Agapitou & Karapetsas, 2005), any sample with girls is inevitably smaller. However, both the male and female students were similar with respect to grades and computer literacy.

Consequently, it is less likely that the gender differences in this study are influenced by these variables; this deduction may indicate that females lack the mastery of necessary computer skills, which results from less computer experience and a lack of conviction that the task is important enough. Therefore, girls might not make the necessary effort to perform it (Underwood, McCaffrey & Underwood, 1990).

The results of this survey can be related with other research studies which, in turn, disclose that boys hold more favorable attitudes towards computers, a greater interest in computer applications and, generally, appear to be more confident about their digital skills (Barak, Lipson & Lerman, 2006; Kay, 2006; Li & Kirkup, 2007; Kadjevich, 2000). All these gender differences in computer-related activities seem to greatly influence the students' performance (Imhof et al., 2007).

Indeed, there is clear evidence (Mitra et al., 2001) that even when students had easy access to computers for over four years, girls continued to be less positively disposed toward computers and therefore used them less frequently. Most probably, deeply embedded cultural norms seem to play a crucial role in shaping girls' attitudes towards computers; thus girls are made to feel less self-confident when dealing with ICT-related tasks.

Research findings also reveal that girls with ADHD were more likely than boys to have the predominantly disruptive type of ADHD (Biederman et al., 2002). This fact may indicate an association with the ADHD girls' less improved writing performance. Moreover, survey data suggested that females may be partially impeded in their academic pursuits due to the fact that they seem to be more distracted than males when they use computers during lessons (Kay & Lauricella, 2011). Kay and Lauricella (2011) have ascribed this female distraction to the fact that males are absorbed in more enticing off-task behaviors.

Also, the inferior performance of the girls in the present survey has nothing to do with the girls' lack of ability to handle the CmapTool software, given that the students (through the specific teaching method) were initiated into the digital environment of the CmapTool and

simply got used to it. More specifically, in the initial phase, the Cmap was structured and designed by the teacher with the main goal to introduce the students to the basic attributes of descriptive writing. Afterwards, the students were provided with a semi-structured Cmap, designed with hierarchical levels but also having certain gaps. The students were asked to fill in those gaps. Although the primary task is to have the students construct a Cmap by themselves, it is of great importance that the teacher leads the students step by step towards the concept mapping software. The semi-constructed Cmaps can help familiarize students with the CmapTools gradually. Consequently, a basic prerequisite for the students' participation in this survey was their technological literacy and not their ability to construct a complete concept map. The only thing students had to do was to fill-in certain clues in the already constructed hierarchical levels of the Cmap. This study tried to exclude any possibility of inadequacy in the concept mapping software utilization on behalf of the girls, which could be linked to their weak performance.

Furthermore, we should also mention that although girls are better at spelling and have a better performance in tests – modeled after Standardized achievement tests (National Center for Education Statistics, 2003) – that measure literacy, competence in writing and general knowledge, they seem to reach a ceiling effect when ICTs interfere in their learning. Thus, ICTs do not really affect them that much.

We should also make clear that the specific findings do not refer to all females in general (with and without ADHD) but only to those with ADHD. So, we cannot draw the conclusion that all girls in general cannot benefit from ICTs as much as they boys. Moreover, regarding the inferior performance of the girls with ADHD, we can hypothesize that it is the certain digital activities that may have restricted their ability of staying attentive during the learning procedure. In this case, it should be investigated what kind of computer-based activities could enhance their concentration and improve their writing performance.

The findings of this case study are encouraging and make a significant contribution to our understanding of the importance of ICT use in teaching students with ADHD. Moreover, there is a general consensus that ICTs do play a significant role in both ensuring and enhancing learning and life-skill programs of students with special educational needs. 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, local History and Biology. Although this teaching strategy is still in a preliminary stage, an improvement, revision and testing can be made to ameliorate this teaching method in the future. This case study has provided a glimpse into the possible ways that ADHD children can be engaged in language learning. It is also time for educators to reconsider ways to provide a more inclusive curriculum for these children by integrating more ICT activities into teaching.

An important limitation of this survey is the restricted time during which the project had to be conducted (2 teaching hours). This was the time allowed by the Greek Institute of Educational Politics when the main researcher applied for entrance permission at state schools. The students were divided into two groups and were taught the same educational material): a) 8 students were instructed with ICT implementation and b) 8 students without it. The results (though they do not increase the reliability of the survey) show that the group who engaged in the ICT-method performed much better compared to the group that had no access to ICTs. The repetition of this phenomenon reduces the serendipity of the results. However, in order for future surveys to render more solid results, the national legislation should eliminate 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 from different age groups, involving a wider range of subjects, academic activities, and software tools and evaluated with different criteria, is necessary. Since the findings regarding gender are restricted to a small number of specific individuals from specific social backgrounds, 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 gender is a factor in students' performance and that boys seem to take more advantage of the integration of ICTs in the learning procedure in comparison with girls.

Conclusions

The present study hopes to contribute to a specific educators' concern: whether combining a teaching proposal with the use of ICTS in an interactive digital classroom environment has any influence on students' performance, and whether gender has any role to play. According to the contemporary postmodern thinking, teaching approaches constitute communicative means of teaching, oriented towards the subject of the teaching process; that is, the student (Sambou, 2012). The significance of the present research lies on the fact that it researches the incorporation of ICTs with a proportionate approach; it delves into the question whether exploiting digital means pedagogically is far more effective when it comes to students with attention deficit. Also, this research considers the students' perceptions in relation to the incorporation of digital means in the teaching process.

The current research can become the springboard for a future investigation of the extent to which educational technology can positively affect both the teaching and the learning process concerning students with attention deficit. It seems obvious that teaching, aided by educational technology, can benefit the students psychologically, since it arouses their attention and interest, facilitates fluent learning and enriches students' experiences. Such a teaching method combines theory with practice and achieves more easily the implementation of basic principles and methods: cooperation, self-action, self-regulation, feedback and individuality. Finally, it offers a more systematic organization as well as classification of the subject matter and leads to a better management of the predetermined teaching time (Nomass, 2013). This study might also 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 studies 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 ADHD children in learning writing.

To conclude, our findings indicate that boys benefit more than girls by this particular ICT intervention. The factor of gender remains active, particularly in relation to computer experience, motivation, feelings of competence and self-efficacy. These parameters may influence students' performance when they are taught the subject matter with ICTs.

Additionally, the above results indicate that an appropriate use of ICTs should be mandatory because inappropriate implementations of ICTs can further push the girls to the margins or exclude them from innovative educational practices and environments (Cox & Webb, 2004; Lau & Yuen, 2011). So, it is not just the mere existence of ICTs that transforms teacher practices. However, ICTs can force teachers to reshape their practices, given a set of

enabling conditions. The way teachers use ICTs in classroom is determined, to a certain extent, by their pedagogical practices and reasoning, and this way influences students' achievement (Infodev, 2015). If ICTs are systematically and meaningfully integrated into high school education, they will offer an opportunity for the greater inclusion of girls with ADHD into the educational process and learning environments and hopefully lead to the elimination of gender differences.

This should be an obligation of all persons involved in the field of education, who share the vision of an educational system that excludes nobody. According to Gee (2000), contemporary teachers who want truly and honestly to tackle the current uneven situation in education must work to make public schools much more effective.

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