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The promotion of cultivating critical thinking skills in Greek Lyceum: a qualitative content analysis of the first-class Informatics textbook

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Abstract

In order to deal with the constantly and rapidly changing conditions of life, a decision-making capacity is needed. Critical thinking can help effectively in this, and that is why it is an ability that modern education seeks to cultivate. In Informatics-related education, critical thinking is essential. Consequently, in Informatics textbooks it is expected that the cultivation of the critical thinking skills will be promoted. This research is aimed to determine whether this is the case in the Informatics textbook of the A-class of the Greek General Lyceum and for this reason, the content of this textbook was examined. The method that has been used is the Content Analysis, which is an established method for analysis of texts in social sciences. The present research has revealed that in the text the promotion of the cultivation of critical thinking skills is insufficient and in such a way that these skills are not treated equally. These findings should be taken into account during educational use of the textbook.

1. Introduction

Modern education internationally seeks to cultivate specific learning competences for the 21st century, including critical thinking (Kennedy, Latham & Jacinto, 2016). Critical thinking helps develop independent thinkers and it is the key competency for economic survival in the 21st century (Matthews & Lally, 2010). Moon (2008) stressed the significance of critical thinking in society and especially in higher education and professions. Students who follow critical thinking courses acquire skills such as solving problems, gathering and analyzing information (Bassham et al., 2011). From the above, it is clear that in the textbooks of Informatics, promoting the cultivation of critical thinking skills is important. The purpose of this paper is to investigate whether and how cultivation of critical thinking skills is promoted through references in Informatics textbook of A-class of the Greek general Lyceum.

1.1. Clarifying critical thinking

The concept of critical thinking is multifactorial, and so it is expected to have varied approaches. There are philosophical, psychological and pedagogical approaches to critical thinking (Kules, 2016; Lai, 2011; Lewis & Smith, 1993; Moon, 2008; Sternberg, 1986).

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Proponents of philosophical approach focus on the requirements of formal logic and they can see critical thinking as a procedure or form of logic (Bowell & Kemp, 2002). The philosophical approach encompasses definitions of critical thinking such as "reflective and reasonable thinking that is focused on deciding what to believe or do" (Ennis, 1985, p. 85), "disciplined, self-directed thinking that exemplifies the perfections of thinking appropriate to a particular mode or domain of thought" (Paul 1992, p. 9).

Cognitive psychologists see critical thinking as a means of problem solving, often considering it as "a form of problem solving" (Moon, 2008). There are definitions of critical thinking based on the psychological approach such as: "critical thinking comprises the mental strategies and representations people use to solve problems, make decisions and learn new concepts" (Sternberg, 1986, p. 3), "the use of those cognitive skills or strategies to increase the probability of a desirable outcome" (Halpern, 1998, p. 450).

Educators focus on how cultivation of critical thinking will take place and see it as an ability that students should develop. They often see critical thinking represented by analysis, synthesis and evaluation, the three highest levels of Bloom taxonomy (Kennedy Fisher & Ennis, 1991).
Perhaps the most widely known systematic study that defines critical thinking was organized and conducted by the American Philosophical Union in an effort to reach a consensus of forty-six experts on critical thinking. The report that emerged from this study is known in the literature of critical thinking as "Delphi Report" and the unanimous statement of the participants about critical thinking is the following: "We understand the critical thinking as a deliberate, self-regulating crisis resulting from an interpretation, analysis, evaluation and conclusions, as well as an explanation of the evidence, conceptual, methodological, critical or contextual considerations on which this crisis is based" (Facione, 1990, p. 2). The present research uses critical thinking skills and sub-skills as they were referred in the Delphi Report.

1.2. Critical thinking and informatics

In order to manage information in a proper way, it is important to develop "Information Literacy" which is a set of skills for recognizing, evaluating and effectively using necessary information (American Library Association, 1989). In Informatics, as a science of computers, algorithms, data structures, mechanical symbol, data processing, computer automation, computer simulation, and mechanization of thinking (Rechenberg, 1999), information literacy is important. Students cannot cultivate Information literacy unless they have developed critical thinking skills (Paul & Edler, 2006). Consequently, Critical thinking, Informatics and Information Literacy are strongly connected.

Computational thinking affects many disciplines, since it has characteristics that are beneficial and necessary to them (Wing, 2006) and there is a strong relationship between concepts of Computer Science and computational thinking (Dagiene & Stupuriene, 2016). According to Selby & Woollard (2014), computational thinking is a brain activity that facilitates problem solving by applying deduction, deconstruction, algorithmic design, generalization, and evaluation to the production of automation that can be implemented by a human or by a computing device. They note that computational thinking makes it easier to solve problems. Critical thinking and computational thinking are necessary in solving complex technological problems (Voskoglou & Buckley, 2012). Critical thinking skills are essential for solving problems and decision-making (Halpern, 1998). Computational thinking complements the critical thinking with regard to problem solving, decision making and interaction with the world, and there are critical thinking skills and computational thinking skills which are similar (Kules, 2016). Consequently, critical thinking, computational thinking and Informatics are interrelated.

Algorithmic thinking is a set of abilities associated with constructing and understanding algorithms. These abilities are: the ability to analyze problems, the ability to accurately identify a problem, the ability to find the key actions that are appropriate to deal with a given problem, the ability to construct an algorithm to solve a particular problem using the basic actions, the ability to

capture possible cases of a problem and the ability to improve the efficiency of an algorithm (Futschek, 2006). Algorithmic thinking is one of the most important competences in education of Informatics (Olsen, 2000). Logic and clarity constitute intellectual standards of critical thinking (Paul & Elder, 2006; Paul, 1992) and they are key elements of algorithmic thinking. Therefore, critical thinking, algorithmic thinking and Informatics are closely related. From the above, it has become clear that critical thinking and Informatics are strongly related.

1.2. Critical thinking and informatics textbooks

Due to the strong relationship between critical thinking and Informatics, cultivating of critical thinking skills should be promoting in Informatics textbooks. Because of the importance of critical thinking, the curricula promote the cultivation of critical thinking internationally. In curricula of primary, secondary and higher education, learning objectives underline the development of critical thinking (Thompson, 2011). Matthews & Lally (2010) stressed that thinking skills or critical thinking programs have been incorporated into curricula of several countries. An indicative example of the Analytical Curriculum for Information and Computer Technology in Education is the one developed under the aegis of UNESCO. According to this Curriculum, one of the skills that should be promoted is critical thinking (Weert & Anderson, 2002).

According to the Hellenic Pedagogical Institute (2009), new curricula present the promotion of critical thinking as a teaching objective. Cultivation of critical thinking skills is a prerequisite for developing skills related to Informatics and it is also promoted by Greek educational legislation at the level of Curriculum. Therefore, cultivating of the critical thinking skills should be promoting in the school textbooks of Informatics. A review has shown that there are no researches on the promotion of cultivating the critical thinking skills in Greek textbooks of Informatics. The informatics course in the first class of the Greek Lyceum corresponds to the textbook which was examined in this paper.

1.3. Research questions

In order to investigate the content of the first-class Informatics textbook of the Greek General Lyceum, concerning the promotion of cultivating critical thinking skills, the following research questions were posed. In the content of the first-class Informatics textbook of the Greek General Lyceum:

1. Is cultivation of critical thinking skills promoted?
2. Which are the critical thinking skills and sub-skills whose cultivation is promoted, and which ones are those whose cultivation is not promoted?
3. If cultivating critical thinking skills is promoted, in what way is this promotion achieved for each skill?

2. Method

2.1. Research design

The research questions refer to whether and how the examined material promotes the cultivation of critical thinking skills, that is to say qualitative elements. In order to answer these questions, it is necessary to examine if there are references in the text where cultivation of critical thinking skills is promoted. A suitable method to examine this and answer the research questions is the Qualitative Content Analysis. Zhang & Wildemuth (2016) point out that Qualitative Content Analysis examines the meanings, themes and patterns that are obvious or latent in a particular text. The main idea of Content Analysis is the inclusion of elements of a text into categories (Berelson, 1952; Creswell & Clark, 2007; Holsti, 1969; Huntemann & Morgan, 2001; Krippendorff, 2004; Mayring, 2014; Rustermeyer, 1992). Qualitative Content Analysis is a systematic methodology of translating the concepts around us into categories for coding (Kohlbacher, 2009; Manzo & Trotter, 2007).

A central issue of this research was to find the references of the text through which the cultivation of critical thinking skills is promoted and the inclusion of these references in a system

of categories. To achieve this, two basic procedures were carried out. First, the recording unit was selected. Second, this system of categories was established.

The recording unit determines which parts of the text fall into the Category System (Krippendorff, 2004). The recording unit is the smallest part of the content in which the display of a message is measured (Weber, 1986). In the present research, the recording unit was defined as a reference which expresses promotion of cultivating critical thinking skills and does not contain any other such reference.

At the beginning of Content Analysis, an initial Category System is used to help classify text parts in the categories of this system. The initial Category System of this work was based on the skills and sub-skills of critical thinking that were defined by the American Philosophical Association (Facione, 1990). This category system is deductive because it is derived from theory. Its categories (skills) and subcategories (sub-skills) are as follows:

1. Interpretation skill
    1.1. Categorization sub-skill
    1.2. Decoding Significance sub-skill
    1.3. Clarifying Meaning sub-skill
2. Analysis skill
    2.1. Examining Ideas sub-skill
    2.2. Identifying Arguments sub-skill
    2.3. Analyzing Arguments sub-skill
3. Evaluation skill
    3.1. Assessing Claims sub-skill
    3.2. Assessing Arguments sub-skill
4. Inference skill
    4.1. Querying Evidence sub-skill
    4.2. Conjecturing Alternatives sub-skill
    4.3. Drawing Conclusions sub-skill
5. Explanation skill
    5.1. Stating Results sub-skill
    5.2. Justifying Procedures sub-skill
    5.3. Presenting Arguments sub-skill
6. Self-Regulation skill
    6.1. Self-examination sub-skill
    6.2. Self-correction sub-skill

After investigating the text, the deductive category system was modified and the arisen system was the final one. The content of the text was examined to see if there are categories that do not contain references. There were found subcategories which did not contain such references. These empty categories are: decoding significance sub-skill, detecting arguments sub-skill, analyzing arguments sub-skill, assessing arguments sub-skill, justifying procedures sub-skill, self-examination sub-skill and self-correction sub-skill. In a final Category System to be used in Content Analysis, there should be no category that does not contain references (Berelson, 1952; Rustermeyer, 1992; Holsti, 1969). For this reason, the above void subcategories were removed from the deductive category system and a final category system was emerged. This final system is inductive due to the fact that it was derived from research data. The categories and subcategories of this inductive system are listed below:

1. Interpretation skill
   1.1. Categorization sub-skill
   1.2. Clarifying Meaning sub-skill
2. Analysis skill
   2.1. Examining Ideas sub-skill
3. Evaluation skill
   3.1. Assessing Claims sub-skill
4. Inference skill
   4.1. Querying Evidence sub-skill
   4.2. Conjecturing Alternatives sub-skill
   4.3. Drawing Conclusions sub-skill
5. Explanation skill
   5.1. Stating Results sub-skill
   5.2. Presenting Arguments sub-skill

2.2. Material

In this research, the examined material is the content of the first-class Informatics textbook of the Greek General Lyceum. The aim of the examined textbook is for students to acquire knowledge, develop skills and shape attitudes related to the applications of Informatics (Aggelidakis et. al., 2010). This textbook is divided into four thematic units: (1) Hardware - Software and Applications, (2) Programming Environments - Applications Development, (3) Communication and Internet, and (4) Internet Collaboration and Security. Each thematic unit is divided into chapters ranging from three to five. Each chapter contains the names of the teaching units, the teaching objectives, questions related to the existing students' experience, the new knowledge and a related terminology. In each chapter there is information supplementary to the main text. The parts of the textbook that were examined are the teaching objectives, the questions, the main text, the side-by-side text and the activities.

2.3. Data collection and analysis

After selecting the recoding unit, establishing the final inductive Category System and selecting the text to be examined, references from the selected text were categorized. A reference in which cultivation of critical thinking skills is promoted was noted and, according to its content, was categorized into one of the subcategories of the Inductive Category System.

After categorizing, appropriate references were included in each subcategory. Subsequently, these references have been briefly described and were presented for each subcategory separately. For the sake of documentation, every description was followed by corresponding original references.

3. Results

Interpretation skill is represented by categorization sub-skill and clarifying meaning sub-skill. With regard to categorization sub-skill, there are references containing teaching objectives which suggest that students should be able to recognize categories of digital material:

"*[…] to recognize the kinds of digital material ...*" (A-class, Lyceum, 2014-2015, p. 26).

Also concerning the categorization sub-skill, there are references describing activities in which students are asked to place applications into categories.

"*[...] record which applications you have used and the category they belong to*" (A-class, Lyceum, 2014-2015, p.24).

Clarifying meaning is related only to issues connected to Informatics and represented by teaching goals referring to understanding process and by teaching activities associated with illustrating process. Regarding the clarifying meaning sub-skill, the related references contain teaching objectives which suggest that students should be able to understand:

1) computational system function:

"*[...] understand the function of the main components of a computational system*" (A-class, Lyceum, 2014-2015, p. 8).

2) the concept of software:

"*[...] to understand the concept of Software [...]*" (A-class, Lyceum, 2014-2015, p. 20).

3) the development stages of Informatics applications:

"*[...] The aim of the chapter is for students to understand the steps taken in the development of an application*" (A-class, Lyceum, 2014-2015, p.44).

4) the necessity of programming environments:

"*[...] The aim of the chapter is to understand the need for both professional and educational programming environments*" (A-class, Lyceum, 2014-2015, p.49).

5) the general usefulness of networks, in particular computer networks and the concept of social networks:

"*The purpose of the chapter is to understand the usefulness of a network and indeed of a computer network*" (A-class, Lyceum, 2014-2015, p. 74),

"*The purpose of the chapter is to understand the meaning of social networks and their use*" (A-class, Lyceum, 2014-2015, p. 124).

With regard to clarifying meaning sub-skill, references were found describing activities, in which students are asked to illustrate the operation and usefulness of Informatics applications:

"*How does 3D printing work? What are the potentialities of using it?*" (A-class, Lyceum, 2014-2015, p. 19).

The above analysis shows that interpretation skill is represented by categorization sub-skill and Clarifying meaning sub-skill and it becomes clear that:

- Categorization sub-skill is related to classifying applications into categories and to recognizing categories of digital material.
- Clarifying meaning sub-skill is related to understanding usefulness, functions, and concepts of informatics matters.

3.1. Analysis skill

Analysis skill is represented by examining ideas sub-skill. With regard to examining ideas sub-skill, there are references containing teaching objectives which suggest that students should be able to recognize:

1) Personal computer parts:

"*... to recognize the parts of a personal computer*" (A-class, Lyceum, 2014-2015, p. 8).

2) Computer systems forms:

"*... to recognize computer systems in their various forms*" (A-class, Lyceum, 2014-2015, p. 8).

3) Computer systems structures and computer evolution:

"*... to recognize the structure of a familiar computing system as well as the evolution of computers as a whole but also of the individual parts*" (A-class, Lyceum, 2014-2015, p. 8).

4) Features of the Informatics development environments:

"*[...] recognize the usefulness and characteristics of integrated application development environments*" (A-class, Lyceum, 2014-2015, p. 49).

5) Modern software that is used on the Internet:

"*[...] recognize the various software platforms currently used in this area*" (A-class, Lyceum, 2014-2015, p. 103).

6) Social Networks in everyday life:

"*... to recognize Social Networks in their everyday life*" (A-class, Lyceum, 2014-2015, p. 124).

Concerning also the examining ideas sub-skill, the corresponding references are presented as a teaching objective which suggests that students should be able to distinguish:

1) Internet services:

"*The purpose of the chapter is to enable students to distinguish Internet services [...]*" (A-class, Lyceum, 2014-2015, p. 87).

2) Synchronous and asynchronous ways of communication:

"*[...] to distinguish modern from asynchronous ways of communication*" (A-class, Lyceum, 2014-2015, p. 119).

3) Applications for protection from Malware:

"*[...] to distinguish the necessary applications for protection against malicious software*" ((A-class, Lyceum, 2014-2015, p. 133).

4) Searching for information and learning on the Internet:

"*[...] Understand the Difference Between Searching for Information and Learning on the Internet*" (A-class, Lyceum, 2014-2015, p. 103).

5) The economic impacts of e-commerce:

"*... to distinguish the economic impacts of e-commerce on society and to report secure ways of electronic transactions*" (A-class, Lyceum, 2014-2015, p. 26).

In the references of examining ideas sub-skill, activities are described in which students are asked to compare:

1) Computers:

"*Can you compare two computers and choose the best?*" (A-class, Lyceum, 2014-2015, p. 8).

2) Uses of software:

"*[...] Each group [...] compare their use with their own proprietary software*" (A-class, Lyceum, 2014-2015, p. 25).

3) Process of construction of technical projects with the life-cycle of applications:

"*Compare the process of building a major technical project (e.g. a bridge, a building) with the life cycle of the application life cycle and capturing the similarities and differences*" (A-class, Lyceum, 2014-2015, p. 72) .

4) Differences in operation of computer devices:

"*Compare and locate the differences in operation between Hub, Switch, Router [...]*" (A-class, Lyceum, 2014-2015, p. 77).

5) Professional programming environments with educational programming environments:

"*[...] Record the main differences between professional and educational programming environments*" (A-class, Lyceum, 2014-2015, p. 53).

(6) Characteristics of networking computer systems:

"*Find the European Statistical Service how many computers are connected to the Internet today and what is the average connection speed. You compared the original data of 1969.*" (A-class, Lyceum, 2014-2015, p. 82).

7) Society without computer with tomorrow computer society:

"*[...] to compare the society of yesterday without computers with the computer tomorrow society*" (A-class, Lyceum, 2014-2015, p. 36).

8) Computer material (software or hardware):

"*UEFI is a standard firmware interface for computers, designed to replace the BIOS. What are its advantages over the BIOS?*" (A-class, Lyceum, 2014-2015, p. 11).

"*What are the differences between DRAMs and SRAM?*" (A-class, Lyceum, 2014-2015, p. 16).

Other references to examining ideas sub-skill, mention activities in which students are asked to relate:

1) Teleworking to various professions:

"*Which of the following works is offered for telework: hairdresser, programmer, decorator, business consultant, translator, architect [...]* "(A-class, Lyceum, 2014-2015, p. 122).

2) The socio-economic fabric to the changes that the Internet has brought:

"*[...] What are the changes that the Internet has brought to the socio-economic fabric?*" (A-class, Lyceum, 2014-2015, p. 26).

(3) Parts of computational systems:

"*How Much Does Hardware Depend on Hardware?*" (A-class, Lyceum, 2014-2015, p. 20).

4) Proprietary to free software:

"*[...] You can create your own table containing the proprietary software you use and the corresponding free software*" (A-class, Lyceum, 2014-2015, p. 25).

5) Older computer users with younger computer users:

"[...] Record the differences that you have observed between 'Digital Indigenous' and 'Digital Immigrants' "(A-class, Lyceum, 2014-2015, p. 40).

6) Native Informatics applications to Internet Informatics applications:

"*[...] Make a comparison table to help you choose between the native application and the Internet application with the criteria that are most important to you [...]*" (A-class, Lyceum, 2014-2015, p. 92),

"*Discuss the role of each part of an educational environment on the Internet. How do the different parties interact?* "(A-class, Lyceum, 2014-2015, p. 105),

"*Was the possibility of distance learning before the Internet? Look for the different forms of distance learning that have been used so far and compare them with Internet learning* "(A-class, Lyceum, 2014-2015, p. 105),

"*Create a dropbox.com account and one at box.com. Record the capabilities offered by the free versions of the two services. You compared the [...]*"(A-class, Lyceum, 2014-2015, p. 118).

7) Concepts of Informatics:

"*Separate into groups and create a conceptual map for the concept of*" Networks "(A-class, Lyceum, 2014-2015, p. 77).

With respect to the examining ideas sub-skill, references were found describing activities in which students are encouraged to:

1) Identify computer components:

"*Open the central unit of a personal computer in the laboratory under the guidance of your professor and identify the building blocks.*" (A-class, Lyceum, 2014-2015, p. 11)

2) Analyze a problem in simpler problems:

"*[...] I am concerned about the problem of buying a new computer. Record the simplest problems where this problem can be analyzed*" (A-class, Lyceum, 2014-2015, p. 47).

From the above data it is clear that analysis skill is represented by examining ideas sub-skill which is associated to:

- Recognizing computer elements, Internet based software, social networks in everyday life.
- Distinguishing e-services, e-commerce impacts, protection software.
- Relating Informatics concepts, software, hardware, technical projects with life-cycle of applications, socio issues, Internet services, socio-economical changes due to the Internet.
- Analyzing a problem into simpler ones.

3.2. Evaluation skill

Evaluation skill is represented by accessing claims sub-skill. Concerning assessing claims sub-skill, references were found in which students are asked to evaluate the reliability of the reason why specific software is used: "*Free software is a great alternative to the location of proprietary software. However, there is a reservation against a large portion of users and at the same time 'pirated' software is being used. [...] Are these reasons valid?*" (First High School, 2014-2015, p. 42).

It is clear that accessing claims sub-skill is related to assessing the reliability of reasons why users prefer particular software.

3.3. Inference skill

Inference skill is represented by querying evidence sub-skill, conjecturing alternatives sub-skill and drawing conclusions sub-skill. In references concerning querying evidence sub-skill, activities are described in which students are asked to investigate evidence about institutions, legislation and technology:

"*Find the institutional framework for teleworking in our country http://www.elinyae.gr (Hellenic Institute for Occupational Safety and Health)*" (A-class, Lyceum, 2014-2015, p. 122).

"*Telework gives employees the freedom to decide on the time and space they will work for. […] investigate whether it has safeguards for both the employee and the company.*" (Lyceum, 2014-2015, p. 143).

Conjecturing alternatives sub-skill is related only to issues related to Informatics and represented only by activities associated with considering process. Regarding the conjecturing alternatives sub-skill, references were found describing activities in which students are encouraged to consider alternative approaches to information processing:

"*[...] Where are supercomputers used today? Is there an alternative approach to processing huge amounts of information?*" (A-class, Lyceum, 2014-2015, p. 11).

Drawing conclusions sub-skill is related to issues related to Informatics or social issues and represented by teaching objectives referring to implementing applications, managing, envisioning and by activities associated with implementing works, confronting and solving processes. Concerning drawing conclusions sub-skill, the related references contain objectives which suggest that students should be able to:

1) Capture ways of future use of Informatics applications:

"*... to be able to answer questions about how they envision the future with even greater utilization and reliability of computer applications*" (A-class, Lyceum, 2014-2015, p. 26).

2) Implement modern integrated applications:

"*The aim of the chapter is for students to implement in practice integrated applications in a modern programming environment, following step by step all phases of the life cycle of applications*" (A-class, Lyceum, 2014-2015, p. 54).

3) Use Internet services:

"*[...] create an account for cloud services for file storage*" (A-class, Lyceum, 2014-2015, p. 110).

4) Manage Internet security, copyright and privacy issues:

"*The purpose of the chapter is to identify and manage Internet security and protection issues.*" (A-class, Lyceum, 2014-2015, p. 133).

"*[...] to properly manage copyright issues on the Internet*" (A-class, Lyceum, 2014-2015, p. 133).

"*[...] to protect their privacy and their personal data on the Internet*" ((A-class, Lyceum, 2014-2015, p. 133).

Concerning the drawing conclusions sub-skill, references were found describing activities in which students are encouraged to:

1) Implement works using Internet-based software:

"*With the help of your teacher, create a closed classroom in the edmodo environment [...]*" (A-class, Lyceum, 2014-2015, p. 130).

2) Address issues related to computer software or computer hardware:

"*If your OS supports it, find your computer's Experience Index. What do you need to upgrade to work better?*" (A-class, Lyceum, 2014-2015, p. 22).

"*Overclocking is the process by which we increase the clock frequency of a processor over that specified by the manufacturer in order to increase performance. What should we be aware of and what consequences are there?*" (A-class, Lyceum, 2014-2015, p. 14),

"*Buying a new computer creates a number of concerns. Which computer do I get? Do I Get The Most Expensive? Do I get a 'surname'? What will I do for my old one? What about all these old computers when we no longer need them? [...]*" (A-class, Lyceum, 2014-2015, p. 42).

"*[...] Each group shall establish a free software program [...]*" (A-class, Lyceum, 2014-2015, p. 25),

"*Install your own local network [...]*" (A-class, Lyceum, 2014-2015, p. 79).

3) Manage problems using computer:

"*Search for and then record difficult problems that can be easily resolved by using the computer. Choose one of these and record the data that needs to be given to a computer to solve it, as well as the result that is expected after it is solved*" (A-class, Lyceum, 2014-2015, p. 47).

4) Implement Informatics applications:

"*[...] Expanded and enriched the application by implementing the proposals relating to the conservation phase*" (A-class, Lyceum, 2014-2015, p. 65).

" *Create a presentation with the key points in the evolution of the Internet*" (A-class, Lyceum, 2014-2015, p. 82).

The above analysis shows that inference skill is represented by querying evidence, conjecturing alternatives and drawing conclusions and reveals that:

- Querying evidence sub-skill is related to investigating evidence about issues related to computer systems.
- Conjecturing alternative sub-skill is associated to alternative approaches to information processing.
- Drawing conclusions sub-skill is related to: envisioning future uses of applications, implementing modern applications, Internet based applications, confronting issues about software or hardware, using Internet services, implementing works using Internet based software, solving problems using computers, managing Internet issues about security, copyright and privacy.

3.4. Explanation skill

Explanation skill is represented by stating results sub-skill and by presenting arguments sub-skill. As far as stating results sub-skill is concerned, students are encouraged to present conclusions of their thoughts which are related to Informatics issues:

"*[...] choose between the native application and the Internet application with the criteria that are most important to you, and present your conclusions to the classroom*" (A-class, Lyceum, 2014-2015, p. 92).

Presenting arguments sub-skill is related to technological and social issues and represented only by activities associated with arguing process. Regarding presenting arguments sub-skill, references were found describing activities in which students are asked to argue about:

1) Addressing issues related to computer software and hardware:

"*You want to install the latest version of Autocad (http://www.autodesk.com/) on a computer in your lab. Does the hardware of your computer allow it? Document your answer*" (A-class, Lyceum, 2014-2015, p. 22).

2) Social consequences of Informatics:

"*Split into two groups. The first group will be positively related to the social consequences of Informatics, while the second will be negatively [...]. To present your arguments in the classroom with the method of interactive debate*" (A-class, Lyceum, 2014-2015, p. 42).

3) Attitudes of software users towards software products:

"*[...] Why can a user be reticent about free software?*" (A-class, Lyceum, 2014-2015, p. 42).

(4) Rules of conduct on the Internet:

"*There is a Code of Ethical Behavior on the Internet, that is, a set of good behavior rules referred to as the general title netiquette. Read more about these rules on the Pan-Hellenic School Network's website and argue why they must be observed.*" (A-class, Lyceum, 2014-2015, p. 126).

5) usefulness of software

"*Record the operating systems you have used. Then, argue for the pros and cons of each of them*" (A-class, Lyceum, 2014-2015, p. 22).

6) usefulness of Internet services:

"*What service model would a developer choose to implement an application, and why?*" (A-class, Lyceum, 2014-2015, p. 114).

7) usefulness of Social Networks:

"*The widespread dissemination of social networks has exacerbated the digital divide of generations. Try to get into the position of the other. To argue about the need for social networking by elderly people by recording cases in which they will be really useful in their everyday lives. Respectively, argue about the need*

to reduce the use of social networks by young people by recording cases where direct social contact has more benefits." (A-class, Lyceum, 2014-2015, p. 143).

8) Copyright issues on the Internet:

"*The SOPA (Stop Online Piracy Act) and the PIPA (Protect IP Act) have recently come to the US. Its purpose was to make difficult or impossible to sell and distribute proprietary intellectual works (such as music or movies) illegally from unauthorized sites inside and outside the US, blocking access to the entire site. Despite good intentions, the proposed legislation has raised a global protest over its positions. Indicatively, Wikipedia, Google, and Twitter sites have been protesting for a day, on January 18, 2012. Where is the lawful safeguarding of copyright and when does censorship begin?*" (A-class, Lyceum, 2014-2015, p.143).

Data analysis shows that explanation skill is represented by stating results sub-skill and presenting arguments sub-skill and reveals that:

- Stating results sub-skill is related to presenting conclusions of thoughts about informatics issues.
- Presenting arguments sub-skill is associated to arguing about: software and hardware issues, social matters in relation with Informatics, usefulness of software, Internet Services and Social Networks.

4. Discussion and Conclusion

From the present research it became clear that in the examined text the promotion of cultivating the critical thinking skills is not sufficient. The promotion of cultivating interpretation, analysis, evaluation and explanation skills is insufficient since these skills are not represented by all their sub-skills in the text and no references were found promoting the cultivation of the self-regulation skill. The inference skill is the only one which is represented by all of its sub-skills. These findings are consistent with the results of other relevant researches. Most of the popular business administration textbooks either do not support or support insufficiently the development of the students' critical thinking (Errington & Bubna, 2015). Activities in social studies textbooks poorly promote critical thinking (Aybek & Aslan, 2016). Insufficient promotion of cultivating critical thinking skills in the examined text could be attributed to a variety of reasons associated with school teaching, with the attributes of textbook authors as educators and as adults, with the difficulties of developing critical thinking and with barriers to critical thinking. Such reasons could be the obstacles faced by educators in teaching critical thinking such as the lack of training in the methodology of critical thinking, the lack of information about educational material that promotes critical thinking, the personal beliefs and prejudices of educators about the content of the curriculum and the way they teach it (Snyder & Snyder, 2008). Some other reasons are the fact that typical school teaching does not encourage high-level thinking skills such as critical thinking (Paul, 1992), the teaching inefficiency and lack of knowledge about what is critical thinking and how it is being promoted (Aliakbari & Sadeghdaghighi, 2013), the inability of many if not all adults to think critically in many cases (Halpern, 1998), the lack of basic reasoning skills from many adults (Kennedy et al., 1991; Gelder, 2005), the difficulties of cultivating critical thinking (Brookfield, 2013; Willingham, 2007) and the barriers to critical thinking such as egocentrism, sociocentrism, unwarranted assumptions, stereotypes, relativistic thinking and wishful thinking (Bassham et all, 2011).

The way of promoting the cultivation of critical thinking skills, depends on the particular skill. References to the interpretation skill are associated with categorizing, illustrating or understanding issues which are related to Informatics. Parts of the examined text concerning the analysis skill are referred to distinguishing, identifying, comparing, relating or analyzing issues which are associated with to Informatics and some of the these text parts also refer to social or economical matters. References to the evaluation skill are associated with assessing the reliability of reasons why users prefer particular software. References to the inference skill are associated with investigating, considering, managing, implementing or using issues related to Informatics and

some of these references are also related to social matters. References to the explanation skill are associated with arguing or presenting conclusions about issues related to Informatics.

Difficulties of promoting the cultivation of the critical thinking skills in school textbooks could be confronted by educating authors of school textbooks on critical thinking issues. Insufficient promotion of cultivating critical thinking skills in the examined textbook should be taken into account during the educational use of this book.

A limitation of the present work is that the findings cannot be generalized to other textbooks. The proposal is to investigate textbooks of various cognitive subjects about their contribution towards the promotion of cultivating critical thinking skills. Such researches could shed light on the quality of existing textbooks and lead to improvements of promoting the cultivation of critical thinking skills in educational material.

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