CRITICAL THINKING WITHIN THE INFORMATICS TEXTBOOK OF THE SECOND CLASS OF THE GREEK LYCEUM

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Abstract

It cannot be denied that there are always problems societies and individuals have to deal with. To confront these problems in living conditions that seem to be constantly and rapidly changing, specific competencies are needed. Critical thinking is indispensable in developing such competencies effectively. It can support identifying, constructing and evaluating arguments. It can also contribute in improving problem solving skills. Critical thinking is essential to develop decision making competencies and communication skills. Furthermore, people can use critical thinking in order to confront their biases, prejudices and stereotypes. It is clear that critical thinking is useful and necessary in multiple areas. For that reason, critical thinking is considered to be a key pedagogical goal in many levels of education. For this reason, modern education seeks to promote the cultivation of critical thinking. In particular, education of Informatics is strongly related to critical thinking. Students cannot develop skills related to Informatics if they cannot think critically. Therefore, critical thinking is essential for teaching Informatics subjects. Consequently, within the Informatics textbooks the cultivation of critical thinking skills should be promoted. The present research aims to determine whether there are critical thinking skills whose cultivation is equally promoted within the Informatics textbook of the second class of the Greek Lyceum. The method used in this paper is Qualitative Content Analysis, which is established in the social sciences for texts analysis. The findings of the present research revealed that within the examined textbook there are no critical thinking skills whose cultivation is equally promoted.

Keywords: Critical thinking, content analysis, informatics, textbooks.

1. Introduction

Critical thinking can be defined as "reflective and reasonable thinking that is focused on deciding what to believe or do" (Ennis, 1985, p. 85). Critical thinking helps develop independent thinkers and it is the key competency for economic survival in the 21st century (Matthews & Lally, 2010). Critical thinking lessons can contribute in improving a range of skills namely solving problems, gathering and analyzing information, drawing conclusions, communicating ideas with clarity and effectiveness (Bassham et al., 2011). Education seeks to cultivate critical thinking (Kennedy, Latham & Jacinto, 2016), because of its multiple benefits.

1.1. Critical thinking and Informatics

Some aspects of Informatics include: understanding and promoting effective organization, analysis, management, and use of information; decision making relying on knowledge or evidence; integration of data, information and knowledge (Collins & Weiner, 2010). Information literacy is a set of skills for recognizing, evaluating and effectively using necessary information (American Library Association, 1989). Hence Information literacy is essential in Informatics. Students cannot cultivate Information literacy unless they have developed critical thinking skills (Paul & Edler, 2006). Therefore, critical thinking, Informatics and Information Literacy are strongly related.

Logic constitutes an intellectual standard of critical thinking (Paul & Elder, 2013) and critical thinking is a reasonable thinking itself (Ennis, 1985; Lipman, 1988). Informatics is a science of computers, algorithms, data structures, mechanical symbol, data processing, computer automation, computer simulation, and mechanization of thinking (Rechenberg, 1999). Logic is strongly related to many subjects of Computer Science (Martel, 2018), hence it is also related to Informatics. Thus, logic

interrelates Informatics with critical thinking. From the aforementioned, it becomes clear that critical thinking and Informatics have a very strong relationship.

1.2. Critical thinking and curricula

The previously mentioned strong linkage between the critical thinking and Informatics indicates that within curricula, cultivation of critical thinking should be promoted. In curricula of the primary, the secondary and the higher education, learning objectives underline the development of critical thinking (Thompson, 2011). Thinking skills or critical thinking programs have been incorporated into the curricula of several countries (Matthews & Lally, 2010). As stated in the Analytical Curriculum for Information and Computer Technology in Education, one of the skills that should be promoted is critical thinking (Weert & Anderson, 2002). According to the Hellenic Pedagogical Institute (2009), the cultivation of critical thinking is presented in the new curricula as a teaching objective. Consequently, within the school textbooks of Informatics the cultivation of critical thinking skills should be promoted. The purpose of this paper is to determine whether there are critical thinking skills whose cultivation is equally promoted within the Informatics textbook of the second class of the Greek Lyceum.

1.3. Research questions

In order to examine the content of the second class Informatics textbook of the Greek General Lyceum, concerning the promotion of cultivating critical thinking skills in its content, the following research questions were posed which are answered in the present research.
Within the second class Informatics textbook of the Greek General Lyceum:
1. Which are the critical thinking skills whose cultivation is promoted, and which are the ones whose cultivation is not promoted?
2. If there are critical thinking skills whose cultivation is promoted, does this promotion occur equally per skill?
3. Are there critical thinking skills which are represented by all their sub-skills?

2. Method

In this research the examined material is the content of the second class Informatics textbook of the Greek General Lyceum. This textbook is divided into three thematic units (Doukakis et al., 2014): Basic concepts, Theoretical Computer Science topics, Applied Computer Science topics. Each unit is divided into chapters ranging from one to five. All the chapters of the textbook were examined.

2.1. Research design

The method used in this research is the Quantitative Content Analysis. Quantitative Content Analysis is a systematic, objective and quantitative analysis of the characteristics of a message (Neundorf, 2002). The main idea of Content Analysis is the inclusion of elements of a text into categories (Creswell & Clark, 2007; Krippendorff, 2004; Huntemann & Morgan, 2001; Rustermeyer, 1992). The recording unit determines which parts of the text fall into the category system (Krippendorff, 2004). In this research the recording unit is defined as any reference that promotes the cultivation of a critical thinking skill. In the beginning of the Content Analysis, an initial category system is used to help classify parts of the text in the categories of this system. In the present research the initial category system that was used consists of the following skills (categories) and sub-skills (subcategories) of the critical thinking as defined by the American Philosophical Association (Facione, 1990):
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

2.2. Data collection and analysis

In the examined text, each reference that promotes the cultivation of a critical thinking skill falls into a corresponding subcategory. In this way, the members of the subcategories were determined. A basic category consists of the members of its subcategories. The frequency of a category is the number of its members. The frequencies and the relative frequencies of the categories were computed.

3. Results and discussion

Within the examined text, no references promoting the cultivation of the self-regulation skill were found. On the contrary, the cultivation of the interpretation skill, the analysis skill, the evaluation skill, the inference skill and the explanation skill is promoted. The relative frequencies of the critical thinking skills whose cultivation is promoted are displayed in table 1.

Table 1. The critical thinking skills whose cultivation is promoted in the examined text and their relative frequencies.

Critical thinking skills	Relative frequencies (f%)
Interpretation skill	7,8%
Analysis skill	18,8%
Evaluation skill	3,1%
Inference skill	68,8%
Explanation skill	1,5%
Total	100,0%

From the final category system, it is clear which subcategories represent each category. Interpretation skill is represented by categorization sub-skill, decoding significance sub-skill and clarifying meaning sub-skill. Analysis skill is represented by examining ideas sub-skill. Evaluation skill is represented by assessing claims sub-skill. Inference skill is represented by drawing conclusions sub-skill. Explanation skill is represented by presenting arguments sub-skill.

The findings of the present research show that in the examined text, the cultivation of the critical thinking skills is not promoted sufficiently since this promotion does not occur with equal frequency per skill. This is consistent with the results of other relevant researches which examined textbooks and revealed that in their content, critical thinking is not promoted sufficiently (Khademi, 2020; Peyró et al.,2020; Samiee et al., 2020; Al-Qahtani, 2019; Es-Salhi & Elfatihi, 2019; Irafahmi et al., 2018; Maki & Horita, 2018; Solihati & Hikmat, 2018; Aybek & Aslan, 2016; Sobkowiak, 2016).

The insufficient promotion of cultivating critical thinking within the examined textbook could be attributed to a variety of reasons such as the difficulties of cultivating critical thinking (Brookfield, 2013; Willingham, 2007), 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), the fact that typical school teaching does not encourage high-level thinking skills (Paul, 1992), the teaching inefficiency and lack of knowledge about what critical thinking is and how it could be promoted (Aliakbari & Sadeghdaghighi, 2013), the inability of many adults to think critically under many circumstances (Halpern, 1998), the lack of fundamental reasoning skills of many adults (Kennedy, Fisher & Ennis, 1991; Gelder, 2005). Moreover, there are barriers to critical thinking namely egocentrism, sociocentrism, unwarranted assumptions, stereotypes, relativistic thinking and wishful thinking (Bassham et al. 2011).

4. Conclusions

From the present research it was emerged that the critical thinking skills whose cultivation is promoted within the examined text are the interpretation skill, the analysis skill, the evaluation skill, the inference skill and the explanation skill. On the contrary, the cultivation of the self-regulation skill is not promoted in the examined material. Furthermore, the cultivation of the critical thinking skills is not promoted equally per skill. The critical thinking skills of analysis, evaluation, inference and explanation are represented by only one of their sub-skills and the interpretation skill is the only one which is represented by all of its sub-skills. A limitation of the present research is that the findings cannot be generalized to refer to other books. It is suggested that research be conducted where the content of the school textbooks and a range of cognitive subjects are studied, with regard to the cultivation of critical thinking skills in them. These types of research may shed light on the quality of the existing textbooks and how they can potentially be used as far as the critical thinking and the promotion of its cultivation is concerned and also provide useful insights that may help the authors in compiling textbooks where the cultivation of critical thinking skills is adequately promoted.

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