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Critical thinking skills in the Greek lyceum: Their promotion within the first class's informatics textbook

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ARTICLE INFO	ABSTRACT
	To solve problems, specific skills are needed. Critical thinking can help develop such skills. It can contribute to improving problem-solving skills, developing communication skills and cultivating decision making skills. Critical thinking is considered to be a key pedagogical goal in education. Education of informatics and critical thinking have a strong relationship since students cannot develop skills related to Informatics if they cannot think critically. Therefore, within the informatics textbooks the cultivation of critical thinking skills should be promoted. The present paper aims to determine to what extent the cultivation of critical thinking skills is promoted in the Informatics textbook of the first class of the Greek lyceum. This textbook contains thematic units referring to hardware-software and applications, programming environments-applications development and communication collaboration and security within Internet. The method that was used is the quantitative content analysis. The present research revealed that within the examined textbook cultivating critical thinking skills is promoted insufficiently, since in the whole text, the cultivation of critical thinking skills is promoted in a small percent of the text it covers. In the examined material, the critical thinking skills whose cultivation is promoted are the interpretation skill, the analysis skill, the evaluation skill, the inference skill and the explanation skill. The interpretation skill is represented by the categorization sub-skill and the clarifying meaning sub-skill. The analysis skill is represented by the examining ideas sub-skill. The evaluation skill is represented by the assessing claims sub-skill. The inference skill is represented by the querying evidence sub-skill, the conjecturing alternatives sub-skill and the drawing conclusions sub-skill. The explanation skill is represented by the stating results sub-skill and the presenting arguments sub-skill. Moreover, it was found that within the examined text, the cultivation of the self-regulation skill is not promoted. The only parts of the examined text in which the cultivation of critical thinking skills is promoted in the largest percentage of the text they cover are the teaching objectives and in the activities. **Keywords:** critical thinking, critical thinking skills, content analysis, informatics, textbooks

INTRODUCTION

Critical thinking plays an essential role in students' study and life, and it is one of the educational goals of higher education in many countries (Fena & Xiaodongb, 2023), it is considered as a key competency of university students (Vachova et al., 2023), it is essential to students in all educational levels (Dantas et al., 2023) and it a blend of skills and dispositions, which are closely related to collaboration, metacognition, motivation, creativity, and academic achievement (Ali & Awan, 2023). There is a correlation between critical thinking and communication skills (Wanah et al., 2023).

Critical thinking is vital for academic success or effectiveness and in the workplace (Li, 2023). Critical thinking skills are very useful in helping students enter the world of work (Sukra et al., 2023). Critical thinking is vital for academic success and effectiveness and in the workplace (Li, 2023), it is essential for developing a future workforce (Aydiner et al., 2023) and social work practice (Rogers & Allen, 2019) and it is very important in changing society in a way that can evaluate reasons, values, pluralism, and diversity (Rulyansah, 2023).

Critical thinking refers to thinking and making correct decisions independently (Rakhimova, (2023), it can be defined as the evidence-based ways in which people decide what to trust and what to do (Heim et al., 2023). Critical thinking is very fundamental in all aspects of life since "as an intellectual activity means developing an ever more accurate worldview and using it well in all aspects of your life" (Jason, 2022). Critical thinking consists of a tool for the interaction of information with thoughts (Erkinovna, 2022). A critical thinker is open-minded and able to construct logical judgments and arguments in order to reach evidence-based conclusions (Ismail, 2023) and understands how to use knowledge in order to confront problems (Raj et al., 2022).

In is necessary to cultivate critical thinking skills in order to create effective individuals (Mihail, 2022). The influence of critical thinking can be seen in academic, professional and personal levels (Abasaid & Ferreira, 2022). In everyday life, everyone needs critical thinking skills to solve problems (Laabidi, 2022). Critical thinking is essential in teaching and learning process (Shamboul, 2022). Education has recognized the importance of developing students' critical thinking skills (Nor & Sihes, 2022). Critical thinking lessons contributes to improving skills such as solving problems, gathering and analyzing information, drawing conclusions, communicating ideas with clarity and effectiveness (Bassham et al., 2011). Critical thinking is of immense importance in the twenty-first century for human beings (Akbar, 2023, Anggraeni et al., 2023) and comprises the key competency for economic survival in this century (Matthews & Lally, 2010).

The present study is one of the few studies exploring the extent to which the cultivation of critical thinking skills is promoted within the content of Informatics school textbooks. It provides useful insights to authors who write textbooks, where the cultivation of critical thinking skills will be adequately promoted. In addition, it provides a methodological tool that can be used to examine if the cultivation of critical thinking skills is promoted within a text.

Clarifying Critical Thinking

Critical thinking encompasses philosophical, psychological and pedagogical approaches to it (Lai, 2011; Lewis & Smith, 1993; Moon, 2008). As far as philosophical approach is concerned, there are 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). Psychological approach is related to definitions of critical thinking like "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). Regarding the educational approach, the critical thinking is often considered to be represented by the levels of analysis, synthesis and evaluation of the Bloom's taxonomy (Kennedy et al., 1991). The critical thinking skills and sub-skills are the following (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

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). Hence, information management is essential in informatics. To develop information management skills, information literacy is needed. Information literacy is a set of skills for recognizing, evaluating and effectively using necessary information (American Library Association, 1989). Critical thinking can help develop information literacy (Yue et al., 2023). Students cannot cultivate Information literacy unless they have developed critical thinking skills (Paul & Elder, 2006). Therefore, critical thinking, Informatics and information literacy have a very strong relationship.

Informatics is a science of computers, algorithms, data structures, mechanical symbol, data processing, computer automation, computer simulation, and mechanization of thinking (Rechenberg, 1999) and thus it is related to computer science. Problem-solving is fundamental, both in informatics and critical thinking. In informatics, solving problems is linked to

computational thinking. Computational thinking is strongly related to computer science (Dagiene & Stupuriene, 2016), and therefore it is related to informatics. 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 (Selby & Woollard, 2014). Computational thinking can support learners' skills so that they become effective problem-solvers (de Jesus & Silveira, 2021). Computational thinking also facilitates the development of competencies related to problem-solving and decision-making (Cano et al., 2021). There are computational thinking skills and critical thinking skills, which are similar and computational thinking complements critical thinking with regard to problem-solving, decision making and interaction with the world (Kules, 2016). Critical thinking skills are essential for decision making and solving problems (Halpern, 1998). Critical thinking and computational thinking are necessary in solving complex technological problems (Voskoglou & Buckley, 2012). The aforementioned imply that there is a strong linkage between critical thinking and Informatics.

The spectrum of critical thinking includes logic, informal logic, and systemic or analytic thinking (Scheuer, 2023). Logic is strongly related to many subjects of computer science (Martel, 2018) and therefore, it is related to Informatics. Critical thinking itself is a reasonable thinking (Ennis, 1985; Lipman, 1988) and logic constitutes an intellectual standard of critical thinking (Paul & Elder, 2013). Consequently, logic is a link between critical thinking and Informatics.

From all the above it becomes clear that critical thinking and Informatics have a very strong relationship. Due to this relationship within Informatics textbooks the cultivation of the critical thinking skills should be promoted.

Critical Thinking and Informatics Curricula

Education seeks to cultivate critical thinking (Kennedy et al., 2016). Due to the fact that critical thinking is strongly related to Informatics, the cultivation of the critical thinking skills should be promoted in Informatics curricula. 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 curricula of several countries (Matthews & Lally, 2010). As stated in analytical curriculum for information and computer technology in education, critical thinking is one of the skills that should be promoted (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, in the school textbooks of Informatics the cultivation of the critical thinking skills should be promoted.

Research Questions

The purpose of the present research is to determine the extent to which the cultivation of the critical thinking skills is promoted within the examined text. In order to fulfill this purpose, the following research questions were posed.

Within the first-class Informatics textbook of the Greek lyceum:

1. Are there parts of the text, where cultivation of critical thinking skills is not promoted?
2. Which are the critical thinking skills, which are represented by all of their sub-skills, and which are the ones, which are not represented by all of their sub-skills?
3. Are there parts of the text, where the cultivation of critical thinking skills is promoted to their greatest extent?

METHOD

Material

In the present research the examined material is the content of the first-class Informatics textbook of the Greek lyceum. This book was selected for examination because it is the only one introductory Informatics textbook in Greek lyceum (senior high school). 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). The textbook is divided into four thematic units: hardware-software and applications, programming environments-applications development, communication and the Internet and collaboration and security within the Internet. Each thematic unit is divided into chapters ranging from three to five. The pedagogical parts of the examined textbook are the teaching objectives, the teaching questions, the main text, the side text and the activities. In these parts the cultivation of critical thinking skills may take place and because of this, all these parts were examined.

Research Design

The method that was used in the present research is quantitative content analysis. Quantitative content analysis is a systematic, objective and quantitative analysis of the characteristics of a message (Neundorf, 2002). Quantitative content analysis has been applied since 1970 (Johnsen, 1993). The main idea of content analysis is the inclusion of elements of a text into categories (Creswell & Clark, 2007; Huntemann & Morgan, 2001; Krippendorff, 2004; Rustermeyer, 1992). The recording unit determines which parts of the text fall into the category system (Krippendorff, 2004). In the present research the recording unit is defined as any part of the examined text, which contains exactly one message promoting cultivation of a critical thinking skill.

Concerning the establishment of the category system, at the beginning of content analysis, an initial category system is used to help classify the parts of the text in the categories of this system. In the present research the initial category system that was used consists of the skills (categories) and sub-skills (sub-categories) of the critical thinking as referred in clarifying critical thinking section.

The content of the text was examined to see if there are categories that do not contain references promoting the cultivation of the critical thinking skills. Such empty categories were found and correspond to the decoding significance sub-skill, the detecting arguments sub-skill, the analyzing arguments sub-skill, the assessing arguments sub-skill, the justifying procedures sub-skill, the self-examination sub-skill and the self-correction sub-skill. However, in a final category system to be used in the Content Analysis, every category should be not empty (Berelson, 1952; Holsti, 1969; Rustermeyer, 1992). For this reason, the above empty sub-categories were removed from the initial category system and a final category system emerged. The categories and sub-categories of this final system are, as follows:

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

Data Collection and Analysis

The under study material is the content of the Informatics textbook of the first class of the Greek lyceum (Aggelidakis et al., 2010). In this under study text, its pedagogical parts are the teaching objectives, the teaching questions, the main text, the side text and the activities. These are the parts of the examined material, where the cultivation of critical thinking skills may take place. All these parts were examined. In the under study material, every text promoting the cultivation of a critical thinking sub-skill was noted and, according to its content, it was categorized into one of the sub-categories of the final category system. If the cultivation of a critical thinking skill or sub-skill is promoted within a text then this text is a categorized text, otherwise is a non-categorized text. In particular, a categorized subset of an examined part is its subset in which the cultivation of critical thinking skills is promoted.

In order to determine the extent to which the cultivation of a critical thinking is promoted within a text, the text should be measurable. To make a text measurable, the length of it was used. In the present research, the length of a text (categorized or non-categorized) is defined as the number of the lines that the text covers. The length of every examined part of the text (teaching objectives, teaching questions, main text, the side text and the activities) was computed. In addition, the length of the categorized subset of every examined part was computed as well. Then, for each examined part, the percentage of the length of its categorized subset to the length of the entire part was calculated.

RESULTS AND DISCUSSION

In the main text, which constitutes the greater part of the examined text, no references related to the promotion of the cultivation of critical thinking skills were found (Aggelidakis et al., 2010 p. 8-40, 43-70, 73-106, 109-141). On the contrary, in the other parts of the examined text references were found that promote the cultivation of critical thinking skills.

The interpretation skill is represented by categorization sub-skill and clarifying meaning sub-skill (Aggelidakis et al., 2010, p. 8, 19, 20, 44, 49, 74, 124). The analysis skill is represented by the examining ideas sub-skill (Aggelidakis et al., 2010, p. 8, 11, 16, 20, 25, 26, 36, 40, 47, 49, 53, 72, 77, 82, 87, 92, 103, 105, 118, 119, 122, 124, 133). The evaluation skill is represented by the assessing claims sub-skill (Aggelidakis et al., 2010, p. 42). The inference skill is represented by querying evidence sub-skill, conjecturing alternatives sub-skill and drawing conclusions sub-skill (Aggelidakis et al., 2010, p. 11, 14, 22, 25, 26, 42, 47, 54, 65, 79, 82, 110, 122, 130, 133, 143). The explanation skill is represented by stating results sub-skill and presenting arguments sub-skill (Aggelidakis et al., 2010, p. 22, 42, 92, 114, 126, 143). Inference is the only critical thinking skill represented by all of its sub-skills. The interpretation skill, the analysis skill, the evaluation skill and the explanation skill are not represented by all of their sub-skills.

The parts of the text, where the cultivation of critical thinking skills is promoted to their greatest extent are the teaching objectives and the activities. The parts of the text that contain the teaching objectives are located on pages 8, 20, 26, 36, 44, 49, 54, 74, 80, 87, 93, 103, 110, 119, 124, and 133 in the examined textbook. The parts of the text that contain the activities, are located on pages 11, 14, 16, 19, 22, 24, 25, 29, 33, 35, 39, 40, 41, 42, 47, 48, 52, 53, 65, 70-72, 77, 79, 82, 84, 86, 92, 97, 100, 102. 105-108, 111, 114, 118, 122, 123, 126, 130, 132, 136, 138, and 140-143 in the examined textbook.

Figure 1 shows an example of teaching objectives related to promotion of cultivating critical thinking skills, which is located on page 26 in the examined textbook.

Διδακτικοί στόχοι

Σκοπός του κεφαλαίου είναι οι μαθητές να κατανοήσουν την επίδραση των υπολογιστών και γενικότερα του ψηφιακού κόσμου στην καθημερινότητα του σύγχρονου ανθρώπου, είτε αυτή εκφράζεται σε ατομικό επίπεδο είτε σε επιχειρηματικό επίπεδο, και να μπορούν να απαντήσουν σε ερωτήματα για το πώς οραματίζονται το μέλλον με ακόμα μεγαλύτερη αξιοποίηση και αξιοπιστία των εφαρμογών υπολογιστών.

Οι μαθητές πρέπει να είναι σε θέση:

√ να αναγνωρίζουν τα είδη του ψηφιακού υλικού και του τρόπου διαχείρισής του για την παραγωγή πολυμεσικών εφαρμογών.

√ να περιγράφουν τη δυναμική του Διαδικτύου και την επίδραση της Διαδικτυακής προβολής στον χώρο των επιχειρήσεων.

√ να διακρίνουν τις οικονομικές επιπτώσεις του ηλεκτρονικού εμπορίου στην κοινωνία και να αναφέρουν ασφαλείς τρόπους ηλεκτρονικών συναλλαγών.

√ να απαριθμούν τις σύγχρονες τεχνολογικές εξελίξεις και εφαρμογές της ρομποτικής.

Figure 1. Example of teaching objectives in the examined textbook (Aggelidakis et al., 2010)

Ερωτήσεις - Δραστηριότητες:
1. Καταγράψτε παραδείγματα για κάθε τύπο ηλεκτρονικών δημοπρασιών.
2. Επισκεφθείτε ένα γνωστό σας ηλεκτρονικό κατάστημα και εντοπίστε τους τρόπους πληρωμής που διαθέτει. Ποιον τρόπο θα επιλέγατε ως ευκολότερο και ποιον ως ασφαλέστερο;

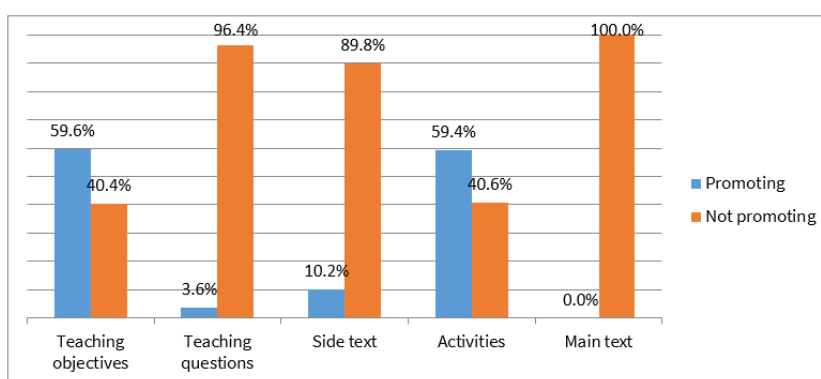**Figure 2.** Example of activities in the examined textbook (Aggelidakis et al., 2010)

Figure 3. Promoting cultivation of critical thinking skills in the examined parts of the text (Source: Authors' own elaboration)

Figure 2 shows an example of activities related to promotion of cultivating critical thinking skills, which is located on page 33 in the examined textbook.

Figure 3 shows percent's of the extent of every examined part in which the cultivation of critical thinking skills is promoted or is not promoted.

DISCUSSION

The findings of the present research are consistent with the results of another relevant research. The self-regulation is a critical thinking skill. In the research of Bogaerds-Hazenberg et al. (2022), the content of Dutch textbooks for reading comprehension instruction was analyzed using material analysis and teachers' evaluation and use of these books was analyzed using semi-structured teacher interviews and it was found little opportunities for self-regulated strategy application. The research of Siahaan (2021) examined English textbooks and revealed that these books do not contain all the critical thinking elements and also do not contain many questions that encourage students' critical thinking. The research carried out by Ilmiah (2021) examined C2 level books and revealed that not all aspects of the perspective of thinking were found in the statement of questions in the examined books. In the research of Hestrian et al. (2021), the content of a textbook was examined, and it was revealed that the textbook contained a few critical thinking elements. The research of Din (2021) examined the role of textbooks in developing critical thinking skills and revealed that the examined textbooks help develop lower order thinking skills, but they remain unable to hone and develop students' higher order thinking and there is a need to integrate activities that help the students develop their critical thinking skills. The research of Perdanasari and Sangka (2021) aimed to analyze the need for developing teaching materials to improve critical thinking skills and showed that the teaching materials used have not led to improve students' skills. High school textbooks and the corresponding teacher's guidebooks were examined in the research of Khademi (2020), and it was found that emphasis on the critical thinking was at a very low level in the content of the examined books. The research of Peyró et al. (2020) analyzed the content of textbooks and showed that the examined material does not promote higher order thinking skills and consequently does not sufficiently foster the development of the critical thinking.

The purpose of the research of Samiee et al. (2020) was to determine the level of attention to the critical thinking components in a school textbook and it was concluded that low level of attention to the critical thinking has been paid in the components of the examined material. The research conducted by Al-Qahtani (2019), examined the extent to which university textbooks help in enhancing student's critical thinking skills and showed that the examined material is insufficient in helping students develop high level of critical thinking skills. The research of Es-Salhi and Elfatihi (2019) aimed to evaluate the promotion of the critical thinking skills in English textbooks and concluded that the examined textbooks do not foster the critical thinking skills of learners adequately. The research carried out by Irafahmi et al. (2018) showed that in the content of accounting textbooks used in universities, little attention to the critical thinking is paid. The research of Maki and Horita (2018), revealed that within school textbooks used in elementary schools, junior high schools and high schools, problems focusing on the critical thinking rarely appear. Solihati and Hikmat (2018) undertook research in order to determine the extent to which the critical thinking is promoted within language school textbooks and the findings showed that the examined textbooks do not contain many tasks promoting the critical thinking. In the research of Aybek and Aslan (2016) it was concluded that the activities in social studies textbooks do not meet sufficiently the critical thinking standards. According to the research of Sobkowiak (2016), the English-as-a-foreign-language textbooks that were examined do not foster sufficiently students' critical thinking. The research carried out by Errington and Bubna-Litic (2015) examined popular management textbooks and showed that the majority of the examined textbooks potentially inhibit or support insufficiently the development of students' critical thinking. In the doctoral dissertation of Ilyas (2015), it was examined, among other things, whether high school textbooks in English as a foreign language facilitate the teaching of the critical thinking skills and it was revealed that the examined textbooks do not sufficiently facilitate the teaching of the critical thinking skills. The doctoral dissertation of Permatasari (2012) showed that the reading tasks in senior high school textbooks do not involve high critical thinking level.

In the present research it was found that promotion of the cultivation of the critical thinking skills is insufficient. This insufficient promotion could be attributed to various reasons. Some reasons are the difficulties of the cultivation of the critical thinking (Brookfield, 2013; Willingham, 2007), the lack of training in the methodology of the critical thinking, the lack of information about educational material that promotes the critical thinking, the personal beliefs and prejudices of educators about the content of the curriculum and the way they teach it (Snyder & Snyder, 2008) and the fact that typical school teaching does not encourage high-level thinking skills (Paul, 1992).

Some other reasons are the teaching inefficiency and lack of knowledge about what is critical thinking and how it could be promoted (Aliakbari & Sadeghdaghighi, 2013; Giacomazzi et al., 2022; Yuan et al, 2022), the inefficiency of many adults to think critically in many cases (Halpern, 1998), the lack of fundamental reasoning skills from many adults (Gelder, 2005; Kennedy et al., 1991). Furthermore, there are the barriers to critical thinking such as egocentrism, sociocentrism, unwarranted assumptions, stereotypes, relativistic thinking and wishful thinking (Bassham et al., 2011).

CONCLUSIONS

The main text is the only part of the under study text, where cultivation of critical thinking skills is not promoted. Inference skill is represented by all of its sub-skills and interpretation, analysis, evaluation explanation skills are not represented by all of their sub-skills. The teaching objectives and the activities are the only examined parts, where the cultivation of critical thinking skills is promoted in the largest percentage of the text they cover. The present research showed that within the examined textbook the cultivation of critical thinking skills is not promoted sufficiently.

The present study is one of the few studies exploring the extent to which the cultivation of critical thinking skills is promoted within the content of an Informatics textbook. It can contribute to providing useful insights that may help the authors in compiling textbooks, where the cultivation of the critical thinking skills is adequately promoted. Furthermore, it provides a method, which can be used to examine if cultivation of critical thinking skills is promoted within a text.

A limitation of the present research is that the findings cannot be generalized to refer to other textbooks. It is suggested that research be conducted, where the content of the textbooks and a range of cognitive subjects are studied, with regard to the cultivation of the critical thinking skills within them. These types of research may shed light on the quality of the existing textbooks and how they can potentially be used concerning the critical thinking and the promotion of its cultivation.

REFERENCES

Abasaid, M., & Ferreira, M. P. (2022). Perception and knowledge of critical thinking: A qualitative research study with professors of higher education in Oman. *Journal of Educational Studies and Multidisciplinary Approaches, 2*(2), 173-190. https://doi.org/10.51383/jesma.2022.38

Aggelidakis, N., Michailidis, A., Blatsios, X., Pesselinas, G., Papadakis, S., Pavlidis, & Tzortbatzakis, A. (2010). *Applications of informatics*. Diophantos.

Akbar, R. A. (2023). Critical thinking as a twenty first century skill. *Journal of Educational Research and Social Sciences Review, 3*(1), 8-15.

Ali, G., & Awan, R. U. N. (2023). The role of critical thinking in mediating the association between instructional practices and academic achievement. *Pakistan Journal of Educational Research and Evaluation, 10*(2), 51-62.

Aliakbari, M., & Sadeghdaghighi, A. (2013). Teachers' perception of the barriers to critical thinking. *Procedia-Social and Behavioral Sciences, 70*, 1-5. https://doi.org/10.1016/j.sbspro.2013.01.031

Al-Qahtani, E. M. (2019). Critical thinking pedagogy: Using textbooks evaluation and content analysis techniques for Saudi university students. *International Journal of Linguistics, Literature and Translation, 2*(5), 239-244.

American Library Association. (1989). *American library association presidential committee on information literacy*. http://www.ala.org/ala/acrl/acrlpubs/whitepapers/presidential

Anggraeni, D. M., Prahani, B., Suprapto, N., Shofiyah, N., & Jatmiko, B. (2023). Systematic review of problem based learning research in fostering critical thinking skills. *Thinking Skills and Creativity*, 101334. https://doi.org/10.1016/j.tsc.2023.101334

Aybek, B., & Aslan, S. (2016). An analysis of the units "I'm learning my past" and "the place where we live" in the social studies textbook related to critical thinking standards. *Eurasian Journal of Educational Research, 16*(65), 35-54. https://doi.org/10.14689/ejer.2016.65.03

Aydiner, C., Corbin, T. B., & Tan, C. (2023). Developing critical thinking and effective communication skills in the future aviation workforce. In *Proceedings of the National Training Aircraft Symposium* (pp. 37).

Bassham, G., Irwin, W., Nardine, H., & Wallace, J. (2011). *Critical thinking: A student's introduction*. King's College.

Berelson, B. (1952). *Content analysis in communications research*. Hafner Press.

Bogaerds-Hazenberg, S. T. M., Evers-Vermeul, J., & van den Bergh, H. (2022). What textbooks offer and what teachers teach: An analysis of the Dutch reading comprehension curriculum. *Reading and Writing, 35*, 1497-1523. https://doi.org/10.1007/s11145-021-10244-4

Brookfield, S. (2013). Teaching for critical thinking. *International Journal of Adult Vocational Education and Technology, 4*(1), 1-15. https://doi.org/10.4018/javet.2013010101

Cano, S., Naranjo, J. S., Henao, C., Rusu, C., & Albiol-Pérez, S. (2021). Serious game as support for the development of computational thinking for children with hearing impairment. *Applied Sciences, 11*(1), 115. https://doi.org/10.3390/app11010115

Collins, J. W., & Weiner, S. A. (2010). *Proposal for the creation of a subdiscipline: Education informatics*. Teachers College Record. https://doi.org/10.1177/016146811011201008

Creswell, J. W., & Clark, V. P. (2007). *Designing and doing mixed method research*. SAGE.

Dagiene, V., & Stupuriene, G. (2016). Informatics concepts and computational thinking in K-12 education: A Lithuanian perspective. *Journal of Information Processing, 24*(4), 732-739. https://doi.org/10.2197/ipsjjip.24.732

Dantas, L., Galego, C., Oliveira, J., Santo, E., Costa, M., Rios, M. J., Lambo, R., & Lobão, R. (2023). Developing critical thinking in secondary education. In *Proceedings of the INTED2023* (pp. 4734-4734). IATED. https://doi.org/10.21125/inted.2023.1237

de Jesus, A. M., & Silveira, I. F. (2021). Marco de aprendizaje colaborativo basado en videojuegos para el desarrollo del pensamiento computacional [Game-based collaborative learning framework for computational thinking development]. *Revista Facultad de Ingenieria, Universidad de Antioquia* [*Faculty of Engineering Magazine, University of Antioquia*]*, 99*, 113-124.

Din, M. (2021). Developing critical thinking through EFL textbooks: A study at secondary and higher secondary school certificate level in Pakistan. *Psychology and Education Journal, 58*(3), 4098-4116.

Ennis, R. H. (1985). A logical basis for measuring critical thinking skills. *Educational Leadership, 43*(2), 44-48.

Erkinovna, I. M. (2022). The importance of critical thinking in the education of junior school age students. *International Journal of Social Science & Interdisciplinary Research, 11*(04), 151-155.

Errington, A., & Bubna-Litic, D. (2015). Management by textbook: The role of textbooks in developing critical thinking. *Journal of Management Education, 39*(6), 774-800. https://doi.org/10.1177/1052562915594839

Es-Salhi, A., & Elfatihi, M. (2019). Evaluating critical thinking skills in Moroccan EFL textbooks: Gateway to English 2 as a case. *Higher Education of Social Science, 17*(1), 13-22.

Facione, P. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction*. http://www.qcc.cuny.edu/socialsciences/ppecorino/CT-Expert-Report.pdf

Fena, H., & Xiaodongb, Z. (2023). The cultivation of critical thinking in senior high school English reading class. *Frontiers in Educational Research, 6*, 6. https://doi.org/10.25236/FER.2023.060605

Gelder, T. V. (2005). Teaching critical thinking: Some lessons from cognitive science. *College Teaching, 53*(1), 41-48. https://doi.org/10.3200/CTCH.53.1.41-48

Giacomazzi, M., Fontana, M., & Trujillo, C. C. (2022). Contextualization of critical thinking in sub-Saharan Africa: A systematic integrative review. *Thinking Skills and Creativity, 43*, 100978. https://doi.org/10.1016/j.tsc.2021.100978

Halpern, D. F. (1998). Teaching critical thinking for transfer across domains: Disposition, skills, structure training, and metacognitive monitoring. *American Psychologist, 53*(4), 449. https://doi.org/10.1037/0003-066X.53.4.449

Heim, A. B., Esparza, D., Holmes, N. G., & Smith, M. K. (2023). Comparing study features is easy but identifying next steps is hard: Evaluating critical thinking through the biology lab inventory of critical thinking in ecology. *Ecology and Evolution, 13*(5), e10071. https://doi.org/10.1002/ece3.10071

Hellenic Pedagogical Institute. (2009). *Interdisciplinary committee on educational autonomy of the lyceum and dialogue on education: Curriculums*. http://www.pi-schools.gr/paideia_dialogos/analitika-programata.pdf

Hestrian, R. A. P., Aliyah, S. L., & Afifah, P. L. D. (2021). A content analysis of critical thinking repesentation in English textbook for twelve grades. In *Proceedings of the UICELL Conference* (pp. 148-152).

Holsti, O. R. (1969). *Content analysis for the social sciences and humanities*. Addison-Wesley.

Huntemann, N., & Morgan, M. (2001). Mass media and identity development. In D. G. Singer, & L. Jerome (Eds.), *Handbook of children and the media* (pp. 309-322). SAGE.

Ilmiah, S. H. (2021). *Critical-thinking perspective in the level C2 Sahabatku Indonesia books*. KnE Social Sciences. https://doi.org/10.18502/kss.v5i3.8533

Ilyas, H. (2015). *Critical thinking: Its representation in Indonesian ELT textbooks and education* [Doctoral dissertation, University of York].

Irafahmi, D. T., Nuris, D. M. R., Zahroh, F. & Nagari, P. M. (2018). Critical thinking in accounting textbooks. *Journal of Education and Learning, 12*(1), 21-29. https://doi.org/10.11591/edulearn.v12i1.6315

Ismail, N. M. (2023). *Developing the learning of critical thinking in higher education: A case study based on an international university in Egypt* [Doctoral dissertation, The University of Liverpool].

Jason, G. J. (2022). *The critical thinking book*. Broadview Press.

Johnsen, E. B. (1993). *Textbooks in the kaleidoscope: A critical survey of literature and research on educational texts*. Oxford University Press.

Kennedy, I. G., Latham, G., & Jacinto, H. (2016). *Education skills for 21st century teachers: Voices from a global online educators' forum*. Springer. https://doi.org/10.1007/978-3-319-22608-8

Kennedy, M., Fisher, M. B., & Ennis, R. H. (1991). Critical thinking: Literature review and needed research. In L. Idol, & B. Fly Jones (Eds.), *Educational values and cognitive instruction: Implications for reform* (pp. 11-40). Lawrence Erlbaum.

Khademi, S. (2020). Content analysis of "religion and life" curriculum in the high school program in Iran in terms of the emphasis on creativity, critical thinking, and self-assertiveness in students. *Biannual Journal of Education Experiences, 3*(2), 121-132.

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology*. SAGE.

Kules, B. (2016). Computational thinking is critical thinking: Connecting to university discourse, goals, and learning outcomes. *Proceedings of the Association for Information Science and Technology, 53*(1), 1-6. https://doi.org/10.1002/pra2.2016.14505301092

Lai, E. R. (2011). Critical thinking: A literature review. *Pearson's Research Reports, 6*, 40-41.

Lewis, A., & Smith, D. (1993). Defining higher order thinking. *Theory into Practice, 32*(3), 131-137. https://doi.org/10.1080/00405849309543588

Li, L. (2023). Critical thinking from the ground up: Teachers' conceptions and practice in EFL classrooms. *Teachers and Teaching*. https://doi.org/10.1080/13540602.2023.2191182

Lipman, M. (1988). Critical thinking–What can it be? *Educational Leadership, 46*(1), 38-43. https://doi.org/10.5840/inquiryctnews19882252

Maki, S., & Horita, T. (2018). Comparative study of the categorization of items of statistical literacy in mathematics textbooks of elementary, junior high, and high schools in Japan. *International Journal of Learning Technologies and Learning Environments, 1*(1), 79-92. https://doi.org/10.52731/ijltle.v1.i1.320

Martel, M. (2018). *Conservative extensions and satisfiability in fragments of first-order logic: Complexity and expressive power* [Doctoral dissertation, Universität Bremen].

Matthews, R., & Lally, J. (2010). *The thinking teacher's toolkit: Critical thinking, thinking skills and global perspectives*. Bloomsbury Publishing.

Mihail, R. (2022). The relevance of critical thinking from the perspective of professional training. *Postmodern Openings, 13*(2), 499-513. https://doi.org/10.18662/po/13.2/468

Moon, J. (2008). *Critical thinking: An exploration of theory and practice*. Routledge Taylor & Francis Group.

Neundorf, K. (2002). *The content analysis guidebook*. SAGE.

Nor, H. M., & Sihes, A. J. (2022). The evolution of citical thinking in the classroom: A bibliometric analysis. *Journal of Positive School Psychology, 6*(3), 540-550.

Paul, R. (1992). Critical thinking: What, why, and how. *New Directions for Community Colleges, 1992*(77), 3-24. https://doi.org/10.1002/cc.36819927703

Paul, R., & Elder, L. (2006). *Critical thinking competency standards*. Foundation for Critical Thinking.

Paul, R., & Elder, L. (2013). Critical thinking: Intellectual standards essential to reasoning well within every domain of human thought. *Journal of Developmental Education, 37*(1), 32.

Perdanasari, A., & Sangka, K. B. (2021). Development needs analysis of teaching materials for improving critical thinking skills students in century 21. *Journal of Physics: Conference Series, 1808*(1), 012035. https://doi.org/10.1088/1742-6596/1808/1/012035

Permatasari, R. (2012). *The critical thinking tasks displayed on the textbooks for eleventh grade students of senior high school* [Doctoral dissertation, Universitas Negeri Semarang].

Peyró, M. C. R., Herrero, E. C., & Llamas, E. (2020). Thinking skills in primary education: An analysis of CLIL textbooks in Spain. *Porta Linguarum: Revista Internacional de Didáctica de las Lenguas Extranjeras* [*Porta Linguarum: International Journal of Foreign Language Didactics*]*, 33*, 183-200. https://doi.org/10.30827/portalin.vi33.26647

Raj, T., Chauhan, P., Mehrotra, R., & Sharma, M. (2022). Importance of critical thinking in the education. *World Journal of English Language, 12*(3), 126-126. https://doi.org/10.5430/wjel.v12n3p126

Rakhimova, M. M. (2023). The different techniques and significance of critical thinking in learning foreign languages. *Scholar, 1*(13), 259-264.

Rechenberg, P. (1999). *Introduction to informatics: A complete presentation*. Klidarithmos.

Rogers, M., & Allen, D. (2019). *Applying critical thinking and analysis in social work*. SAGE.

Rulyansah, A. (2023). The perceptions of critical thinking and inclusive practice among primary school teachers. *Jurnal Basicedu, 7*(1), 171-188. https://doi.org/10.31004/basicedu.v7i1.4593

Rustermeyer, R. (1992). *Practical-methodical steps of the content analysis*. Aschendorff.

Samiee Zafarghandi, M., Seadatee Shamir, A., & Shamsolahi, M. (2020). A comparative study of fifth grade mathematics textbooks in Iranian and international schools based on critical thinking components. *Iranian Journal of Comparative Education, 3*(1), 624-635.

Scheuer, J. (2023). Science and the spectrum of critical thinking. In N. Rezaei (Ed.), *Brain, decision making and mental health* (pp. 37-56). Springer. https://doi.org/10.1007/978-3-031-15959-6_3

Selby, C., & Woollard, J. (2014). *Refining an understanding of computational thinking*. https://eprints.soton.ac.uk/372410/1/372410UnderstdCT.pdf

Shamboul, H. A. E. (2022). The importance of critical thinking on teaching learning process. *Open Journal of Social Sciences, 10*(1), 29-35. https://doi.org/10.4236/jss.2022.101003

Siahaan, H. S. (2021). *Manifestation of critical thinking questions in the Indonesian intermediate EFL textbooks*. http://repository.umsu.ac.id/bitstream/handle/123456789/16606/SKRIPSI%20HALIMAH%20SAMANIAH%20SIAHAAN.pdf?sequence=1

Snyder, L. G., & Snyder, M. J. (2008). Teaching critical thinking and problem solving skills. *The Journal of Research in Business Education, 50*(2), 90.

Sobkowiak, P. (2016). Critical thinking in the intercultural context: Investigating EFL textbooks. *Studies in Second Language Learning and Teaching, 6*(4), 697-716. https://doi.org/10.14746/ssllt.2016.6.4.7

Solihati, N., & Hikmat, A. (2018). Critical thinking tasks manifested in Indonesian language textbooks for senior secondary students. *Sage Open, 8*(3), 2158244018802164. https://doi.org/10.1177/2158244018802164

Sternberg, R. J. (1986). *Critical thinking: Its nature, measurement, and improvement*. National Institute of Education.

Sukra, I. W., Widiyanti, N. L. P. M., & Sholekah, M. Y. (2023). The comparison of students' critical thinking skill by the implementation of think pair share and student teams achievement division cooperative learning model in biology instruction at SMAN 2 Singaraja. *Jurnal Matematika, Sains, dan Pembelajarannya* [*Journal of Mathematics, Science and Learning*]*, 17*, 1.

Thompson, C. (2011). Critical thinking across the curriculum: Process over output. *International Journal of Humanities and Social Science, 1*(9), 1-7.

Vachova, L., Sedlakova, E., & Kvintova, J. (2023). Academic self-efficacy as a precondition for critical thinking in university students. *Pegem Journal of Education and Instruction, 13*(2), 328-334. https://doi.org/10.47750/pegegog.13.02.36

Voskoglou, M. G., & Buckley, S. (2012). Problem solving and computers in a learning environment 2. The PS process: A review. *Egyptian Computer Science Journal, 36*(4), 28-46.

Wanah, H. N., Jamaluddin, A. B., Zahra, F., Zubaidah, S., & Arsih, F. (2023). Critical thinking, communication skills and biology learning outcomes: Are they correlated? *AIP Conference Proceedings, 2569*(1), 020018. https://doi.org/10.1063/5.0112421

Weert, T. V., & Anderson, J. (2002). *Information and communication technologies in education. A curriculum for schools and program of teacher development*. UNESCO.

Willingham, D. T. (2007). Critical thinking. *American Educator, 31*(3), 8-19.

Yuan, R., Liao, W., Wang, Z., Kong, J., & Zhang, Y. (2022). How do English-as-a-foreign-language (EFL) teachers perceive and engage with critical thinking: A systematic review from 2010 to 2020. *Thinking Skills and Creativity, 43*, 101002. https://doi.org/10.1016/j.tsc.2022.101002

Yue, F., Ismail, H. M., Ning, H., Ren, W., & Shi, J. (2023). Combining SATI and SPSS analysis to study the status of the cultivation of critical thinking in English teaching in China. In *Proceedings of the 2022 3rd International Conference on Artificial Intelligence and Education* (pp. 173-177). Atlantic Press. https://doi.org/10.2991/978-94-6463-040-4_26