CRITICAL THINKING AND PROBLEM-SOLVING: FROM HIGHER EDUCATION TO PROFESSIONAL CONTEXTS

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Abstract

The critical thinking is a mental process that requires analysis and evaluation of information. It's a very important skill, mentioned in several international Standards of Information Literacy and in important documents on Education, published by organizations of reference like UNESCO or Associations very recognized of the areas of Libraries, Technologies and Education. It's a key competency of the 21st century, included in the well-known 4 Cs: Communication, Collaboration, Creativity and Critical Thinking and it's interrelated with other competencies.

In fact, critical thinking is often associated with problem-solving and decision making, and it's considered to be fundamental to the academic, professional and social success of individuals, living in the information society.

According to the complexity of a global world in which new information and communication technologies abound, it's essential to train citizens to adopt reflective and critical attitudes about the many information products whose quality is often doubtful or inadequate for the informational needs of the individual.

Given the information overload, especially on digital platforms, it's crucial that information users be taught to search for information, select, use and communicate credible information in an ethical manner. So, because such skills are not innate, they need to be taught, whether in formal or informal contexts of learning.

The researcher, also a teacher of higher education, motivated by the results of earlier research carried out in Portuguese polytechnical higher education on the development of information literacy skills, intends to deepen issues related to the critical thinking, crucial for the global formation of the human being and for the success of organizations.

The purpose of this research is to reflect on how the teaching system - especially higher education - values and teaches to develop this essential competence for the integration and success of those who are in an academic process training and who will later have to demonstrate it in the professional reality, since that skill is one of the most required by the labour market.

The methodology adopted is based on a theoretical approach to the theme - through the literature review - and the sharing of experience in the way the teacher has adopted some pedagogical strategies that she considers appropriate to the development of this skill.

The results of the research are the theoretical and practical analysis of good pedagogical practices. Also, the elaboration of a set of questions to reflect on the relevance and added value that the critical thinking can bring in the decision-making process - whether in the academic world or in the professional world, can inspire new approaches and improvements.

It is concluded that the pedagogical approach on the subject under study is complex and that the most successful cases will result from collaborative work by the various educational agents involved. It highlights the importance of the Ministries of Education and their teaching policies, the directions of schools, teachers, students and employers. There should be a general awareness of the importance of developing this skill in the educational community, greater visibility of its

presence in curricula, effective and systematic teaching along the academic path (betting on early education) and institutional support and commitment indispensable for its consolidation.

Keywords: Critical Thinking, Problem-Solving, Education, Labour Market

1 INTRODUCTION

It's unavoidable the importance of critical thinking, a key competence of the 21st century and internationally considered as crucial for the well-being and progress of individuals, organizations and nations.

It's assumed that to think critically is not an innate quality of the human being, and therefore, given its priceless value, it has to be cultivated in various informal and formal learning contexts. However, it's in the educational context that the researcher and also teacher at a higher polytechnic institute, believes that this research is timely. Thus, it is intended to analyse how the higher education system responds to a need for student training that is not yet properly valued by different educational agents with responsibilities in the field.

Several authors argue that it's essential to give an urgent response to training for students and also to teachers who should help grow their trainees globally along their path and shouldn't continue to value only the technical-scientific content.

The methodology adopted corresponds to the literature review on the subject under study, aiming to bring together a set of theoretical concepts and good practices in the development of critical thinking (CT) and problem-solving in the academic context. Simultaneously, it is intended to illustrate how students should be prepared for the professional challenges and demands of the labour market, not separating the school reality from the real world.

Similarly, it is our goal to share pedagogical experiences in one course in the area of Information Science in which it is believed to have contributed to create conditions conducive to the development of this skill and others related to it.

The obtained results bring together the theoretical foundation and the results of the teaching-learning practice disclosed here, pointing to ideas to implement, in the training of any graduate who will have to defend himself, thinking critically in different contexts of his life. This and other associated skills are certainly crucial for surviving, combating information overload and likely manipulations that the information and knowledge society can't avoid.

The conclusions point to the need for changes that give more visibility to the subject and raise awareness that the improvements are the joint and effective work of several stakeholders, remembering that the academy must develop its work, taking into account the needs of the professional world.

2 METHODOLOGY

To better frame the theme under study, we start from the literature review and then we will report a pedagogical practice of Problem Based Learning - PBL which, according to some authors, enhances the development of this and other important skills.

The importance of key skills such as 4 C- Critical thinking and problem-solving, Effective communication, Collaboration and team building and Creativity and innovation is recognized by important associations not only in the area of Education but also in the world of work. A good example of such situation is the American Management Association (AMA) who has developed

an important study of these skills and their organizational importance among 768 managers and other executives. AMA defines it as "the ability to make decisions, solve problems, and take action as appropriate" [1, p.2].

In order to better understand the scope of the concept of critical thinking, we invoke some institutions that have been showing concern for this and other skills for some time, creating Standards for students to develop them. Let us cite the case of American Library Association - ALA, which since 1998 has published a major publication on the subject and who has been developing a continuous update work. So in 2009, the standard number 2 predicts that students will "continue an inquiry-based research process by applying critical thinking skills (analysis, synthesis, evaluation, organization) to information and knowledge in order to construct new understandings, draw conclusions and create new knowledge" [2, p. 50]. Likewise, the International Society for Technology, in 2007, names the fourth item of the *National Educational Technology Standards for Students (NETS-S)* as "Critical thinking, problem solving, and decision making", recommending the use of critical thinking skills in problem-solving and responsible decision making, through digital resources [3].

More recently, The National Education Association - NEA [4] highlights the following important points about CT: 1. Reason Effectively; 2. Use Systems Thinking, 3. Make Judgments and Decisions and 4.Solve Problems. The first point - Reason Effectively - is recommended to diversify types of reasoning, according to the situation (induction, deduction). Concerning the second point, the analysis of the interaction of the different parts of a whole is requested in order to create overall outcomes in complex systems. Concerning the item Make Judgments and Decisions, four aspects are listed: i) Analysis and effective evaluation of evidence, arguments, claims, and beliefs; ii) Synthesis and connections between information and arguments; iii) Interpretation of information and conclusions based on the best analysis; iv) Critical reflection on learning experiences and processes. Finally, the problem-solving item encompasses two procedures: solving different types of unknown problems in conventional and innovative ways and identifying significant questions that help clarify various points of view and make better solutions [4].

An important report from the employers' perspective - *The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution* - supports the idea that they, in addition to hard skills, greatly value soft skills of their current employees and of those who will be hired. This document mentions 35 core work-relevant skills and abilities commonly used in many different sectors of industry and they are included in three major groups - Abilities, Basic skills, Cross-functional Skills. We highlight Critical Thinking, considered a basic skill and other related skills, such as Logical Reasoning (integrated in the Abilities group), as well as Judgment and Decision-making and Complex Problem-Solving, included in the Cross-functional Skills group). Among others, critical thinking "will be a growing part of the core skills requirements for many industries" [5, p.23].

The importance of 4 C is underlined in the AMA survey through the testimony of managers and executives who recognize that these skills "have been articulated within their organizations as priorities for employee development, talent management, and succession planning" [1, p.2]. Also in this document, most managers interviewed confirm that there is an annual employee evaluation of these skills when the performance appraisal is made and that during the hiring process an assessment of these skills is also made to job applicants. When asked to rank in order of importance the 4C skills that help grow their organization, the largest percentage of managers surveyed mark critical thinking as the skill they consider most important - 70% "Most important" while 27.2% mark it as "Somewhat important", the sum of these two highest levels on the Likert scale being the highest relative to the other skills. The second skill considered "Most important" is Communication skills (63.7%), the third is Creativity and innovation 63.6% and the 4th is Collaboration / team building - 51.5%. Therefore, it is highlighted by those who have leadership responsibilities the importance of critical thinking in the organizational context [1].

The awareness that in order to achieve a common good in global society, Education plays a key role in abandoning a passive and uncritical posture through the development of critical thinking, This is a visible idea in the document published by UNESCO *Rethinking education - Towards a global common good* : "In the changing global landscape of education, the role of teachers and

other educators is vital for developing critical thinking and independent judgment, rather than unreflective conformity" [6, p.17].

UNESCO argues that a new approach to Education, with necessary changes and improvements, involves the development of this skill, as well as independent judgment and debate. It's unequivocal the message that a sustainable future for all is achieved through changes, through the transformative action of the School and that "critical thinking, independent judgment, problem-solving, and information and media literacy skills are the keys to developing transformative attitudes" [6, p. 38].

Also The World Bank Group observes the advantages of individuals mastering several competencies, which help them facing the challenges of a changing world. Referring to multidimensionality, dynamism and interactivity of skills, critical thinking is considered a foundational skill and it's in the same group that includes literacy, numeracy, and problem-solving. Concerning necessary changes in Education and its connection to workforce, it's mentioned the importance of students having more developed critical thinking and socioemotional skills, at the moment they enter the job market [7].

Since this skill so important is not innate, the idea is that it should be taught in the education system and as early as possible. The focus of our attention is on higher education, where, with few exceptions, there is a widespread lack of investment in critical thinking, namely in the Portuguese case, as Franco, Vieira and Saiz express [8]. Thus, these authors advocate explicit and deliberate teaching of this skill, training, so that teachers know how to teach it, as well as its integration into curriculum and pedagogical practices.

The way teachers can successfully foster critical thinking in students, both in academia and beyond the classroom, must be done by taking into account the characteristics and needs of the students and by mobilizing other skills, already mentioned - 4C. Like this, teachers should help learners to think, come up with ideas, find solutions, communicate their thoughts and values in their own words, in a collaborative environment. "Such an approach should create the grounds for CT to emerge and transfer to other spheres of students' lives, in the form of ethical, committed and active citizenship in the community" [9, p. 135].

But given the need to teach to think well, to think better, to think critically in the education system, the question and challenge is how to do it in a motivating way for students, helping them to face it naturally and not as an educational imposition. Teachers should have the art of teaching critical thinking in a practical approach, applicable in everyday life, something that should be an added value to achieve personal well-being, with advantages transferable to the academic, social and professional levels. Saiz and Rivas [10] reflect on these issues and draw attention to the great difficulty that teachers have to teach to think, doubt, question, reflect in a society where such values do not abound and where what counts is the immediate, the material goods, the visual, the playful. Suggested solutions include simulations of everyday life, Problem Based Learning (PBL), skills integration and production (in teaching, understanding implies production, for example, if a problem is solved with decision making, students should write an identical problem).

This study and similar researches also intend to measure whether the formative action on critical thinking carried out corresponds to improvements in student performance. To this end, an evaluation test on the subject - PENCRISAL - was applied integrating questions about deduction, induction, practical reasoning, decision making and problem-solving given before and after a critical thinking course and the results point to a very satisfactory overall improvement, after the course, at a global level and in almost all dimensions evaluated, which proves that the teaching methodologies and strategies were a success [10]. The same authors, in 2015, in a similar study, want to know if the competences acquired in the 1st year of the Psychology degree, in a course on critical thinking, persist in the 4th year students. Although the final data collected from the research should be interpreted with some caution, as it is a small sample, the results are very positive. It is concluded that the skills under study not only remain over time but also improve significantly at the end of the training, both in terms of overall results and in 4 out of 5 thought items of PENCRISAL critical thinking test [11].

Still in 2016, in another research of these researchers that aimed at a comparison between two different instruction techniques, they reach the same conclusion - although with some differences, the specific training on the subject (in both types of training) it reflects better and highly satisfactory results in all students attending both courses, as demonstrated by the pre-post assessment of critical thinking in several dimensions [12].

Another study conducted in a Portuguese university by Franco and Almeida [13] also concludes that the effect of general education on higher education brings improvements in the quality of students' critical thinking. Thus, to measure the development of the competency under study, the researchers applied the Halpern Critical Thinking Test to a group of freshman students taking a degree course and a group of master's degree. The research also aimed to investigate whether the area of study had an influence on the performance of students' critical thinking, and therefore the sample consisted of students from two different scientific fields - Social Sciences and Humanities and Science and Technologies, in a total of 332 individuals. The results show that there are differences in performance between master students and 1st year students, the results of the first being better than those beginning the study cycle. It is also concluded that students attending classes in Science and Technologies score higher than those who attend classes in Social Sciences and Humanities. If in this research there was no specific training for the development of critical thinking and better results are registered in the students of more advanced academic years, it can be concluded that the longer the duration of the general academic education, the more benefits are obtained by the students at this specific level.

Even in the context of critical thinking training, it seems interesting to mention an investigation carried out at the Portuguese Catholic University under the project Seminars of Critical Thinking, in which the evaluation of the results is not done through a specific test but through students's perspective. Therefore, at the end of the training, they are invited to make an assessment of the seminar through open answering on strengths, limitations and suggestions. The project implemented with 60 students, over 4 sessions, for a total of 12 hours, aimed to explore thought processes on topics important to students and with a practical impact on their lives. The strategies adopted were the production of texts, the defense of different points of view, the debate in the class and the production of an individual text, describing a decision making process with its justification. We highlight some of the results that now corroborate, by the voice of the learners, some ideas mentioned in other researches. Most students (80%) mention advantages related to cognitive processes (mental processes related to perception, memory, assessment and classification of information, knowledge base). 71.6% consider the adopted strategies - the group work and the debate - as positive and potentiating the CT development and 45% refer the development of communication and argumentation skills. For most students the limitations pointed out are related to the fact that it is a compulsory subject, with absences regime and evaluation component, without counterparts at the level of ECTS [14]. Regarding the limitations mentioned, we think that a change in the evaluation methodology could be seen as useful and motivating, from the perspective of students who want to see their work effort compensated and have academic success.

About training and the students point of view, we'll share, now, part of the results of our research developed in the PhD Thesis [15]. In this study, carried out at a higher school of the Polytechnic Institute of Porto, involving a total of 505 students from eight undergraduate degrees, students were invited to self-assess the development of information literacy skills in an academic context. Their overall evaluation for the seven skills considered is quite good. According to the Likert scale from 1 to 5, wich 1 corresponds to the lowest value and 5 to the highest value of the scale, we present, in descending order, the skills that students consider that, on average, are more developed in the teaching-learning process - (i) autonomy in learning - 3.97, ii) teamwork - 3.89, iii) development of critical thinking - 3.75, iv) communication of information using appropriate means - 3.72, v) safe, legal and ethical use of information - 3,70 vi) Search for information to solve problems-3,68 vii) Evaluation of the quantity, quality and relevance of the selected information - 3,62. As can be seen, out of seven competencies, critical thinking ranks third in the student ranking, in a context where there is no specific training for this purpose, which may mean that learners understand that the overall training received in Higher education contributes a lot to the development of this skill. We interpret the preference of learning autonomy and teamwork as a result of teaching methodologies, in the Bologna framework, where the student is at the center of the learning, should do an individual work and relate to others, adopting a critical posture.

Finally, and considering that the development of skills is done in an integrated way, in the educational process, we refer to an academic experience that has been repeated for three years (since 2016 to 2019) at the undergraduate degree in Library and Information Sciences and Technologies of ISCAP - Porto Politechnic Institute. In the course of Theories and Methods in Communication and Information Sciences (2nd year and 2nd semester) of the scientific field of Information Science, teaching methodology adopted is the Problem Based Learning (PBL), which is advised for the development of several skills, including the critical thinking and there was a high approval rate.

In this course, the teacher gives a list of bibliography and asks learners written questions in a worksheet. Sometimes she gives a theoretical introduction to subjects before and, other times, she makes the theoretical synthesis at the end of the worksheet. Classes are held on computers, so that students can research the recommended sources of information and other scientific articles they deem appropriate. In this way, they search on the Internet, they collect, select, evaluate and use the appropriate information to the academic objective - the resolution of an informational problem.

In selecting good information for their informational needs, they are motivated to use critical thinking, eliminating dubious or unreliable information and using credible information published in reliable sources, preferably scientific databases. And in order to perform this task related to the evaluation of information, they also have to think critically about verifying the existence of the quality criteria of information (subject they had learned the year before).

Students perform their individual research work predominantly in class and, desirably, may complete it outside of class. At the moment they must answer the questions, they have to critically analyze, synthesize, organize and interpret the appropriate information. Simultaneously, it's valued by the teacher the question of the rigor of academic writing with respect to literal and conceptual quotations, which is related to the issue of communication, the ethical use of information, skills that are inevitably also called in this teaching methodology.

In class, the teacher follows the evolution of the students' work, monitoring them individually, clarifying doubts, giving advices on the formal aspect and content of the texts, making them think more deeply about the structuring and coherence of ideas of their discourse. Likewise, with practical examples produced by the students themselves, the teacher insists on the imperative need to avoid plagiarism, through the use of citations and references. This aspect should be transversal in the training of all graduates and it's a consolidation of essential subjects taught to students of an Information Science course. These graduates, therefore, in the academic context, are being trained to be critical, rigorous and ethical in the use of information, which prepares them for professional ethics and deontology issues when entering the job market.

There are a number of classes destined to each theme and at the end of the individual work, which does not prevent information exchange between students, classes are reserved for sharing the answers. Here attention is drawn to the core aspects of the subjects under study, some excerpts from diferent articles that consolidate the most important ideas are reread, student responses are explored and compared, proposals for improvement are made. An oral debate is promoted in which students are invited to intervene actively and participatively, expressing their opinions in an argumentative way or refuting different points of view, in short, developing critical thinking on topics in which they have deepened their knowledge.

After this phase of the teaching-learning process where there is a collective exchange of ideas in the class, students can improve their individual responses by being given another three days to publish their worksheets in moodle in a folder created for this goal. In the two assessment moments (two tests), students can refer to the worksheets they have done before, something that motivates and interests them within their academic success.

In academic year 2018-19, at the end of the semester, an anonymous survey on the functioning of the course was prepared to analyze and introduce improvements in the teaching-learning process. In the class under study, with 24 students enrolled, there were a total of 17 respondents. Among others, one of the questions about the development of some skills, including the critical

thinking, stands out. Given the question "What information literacy skills do you think you have developed in this course? (Indicate 1 for the most developed, 2 for the next, and so on until 5 or 6). 1. Ability to synthesize, 2. Ability to analyze, 3. Critical thinking, 4. Ability to solve informational problems, 5. Ethical communication of information and 6. Other? Which? There was a 100% response rate.

According to Table 1, it can be seen that the highest percentage of students consider that the most developed skill in this course is synthesis capacity (41.1%), followed by analysis capacity and critical thinking capacity (29.4% *ex aequo*).

Table 1- Student choices priority

		STUDENT CHOICES PRIORITY											
		1		**2**		**3**		**4**		**5**		TOTAL	
		N	%	N	%	N	%	N	%	N	%	N	%
S	Synthesis	7	41,1	4	23,5	3	17,7	0	0	3	17,7	17	100
K	Analysis	5	29,4	9	53	2	11,7	1	5,9	0	0	17	100
I	Critical thinking	5	29,4	3	17,7	3	17,7	4	23,5	2	11,7	17	100
L	Problem-solving	3	17,7	0	0	2	11,7	6	35,3	6	35,3	17	100
L	Ethical Commun.	0	0	1	5,9	4	23,5	5	29,4	7	41,1	17	99,9
S													

However, the highest total for students' first and second choices is for analysis capacity (82.4%), followed by synthesis capacity (64.6%) and third for critical thinking (47.1 %). Thus, although students do not indicate critical thinking as a first priority, this skill, out of five, is considered by the third largest percentage of students as the one they most develop in this type of course. In opposition to the best results, problema-solving is a skill rated by most students as poorly developed, with 70.6% of respondents choosing it at the lower levels of the Likert scale (levels 4 and 5). Probably the students did not realize the following message conveyed by the teacher - that by carrying out this research project, they would be solving informational problems.

This self-assessment is a simple indicator of students' perspective and the results cannot be generalized because the sample is small and no pre-post test was applied to confirm students' progress before and after training.

However, in the context of the literature review, we confirm that PBL is a methodology that enables the development of several skills at the same time and, in our opinion, it may be less artificial than enhancing the development of one competency alone. Also, these results allow us to conclude that other strategies can be adopted to improve learners' performance on critical thinking, namely being more explicit from the beginning of the course that students have to demonstrate in their discourse their critical point of view and invest more, in class, in collective exercises of textual interpretation in this perspective.

Of course, similar strategies could also be applied in relation to ethical communication, with one of the worst assessments, as most students consider it to be less developed (70.5% of respondents choose levels four and five of the Likert scale). Probably, at the beginning of the semester, the distribution of a score grid for each of the skills to be assessed in the tests could make students more aware that they should develop them because they are important for their performance and academic success.

In this process of teaching and learning, one thing that is clear and important is that students have an active and proactive role, they are the protagonists in the construction of their knowledge, while the teacher is the mediator who guides and helps them think (better, we hope), rethink and reflect critically.

3 RESULTS

The results of this study on critical thinking are contributions from the literature review and the pedagogical experience. Thus, by using the CT, we intend to ask some questions about the most important aspects of a complex subject that has been the subject of general increasing attention, believing to make a modest contribution to reflection and eventual improvements.

Major world bodies and educational and labour institutions increasingly value key skills, including critical thinking, and interest in research on the subject is growing. Although at higher education level there is more awareness of the topic, one wonders if it's sufficient. In the context of Bologna, where there is a reduction in teaching hours, focusing on the core subjects, is there any concern and action at the institutional culture level to compensate for these changes? To what extent do the study plans allow for the explicit inclusion of subjects that systematically and deliberately address transversal competences? And who should teach how to develop these skills? All teachers, any in particular or both situations?

It has been proven that students who receive specific training in critical thinking have better results in this area than those who don't receive it. It will be evident to educational institutions that this should be a major challenge for a more comprehensive global education, because critical students are better professionals, better prepared for good decision-making and more participative citizens?

And with regard to the idea that critical thinking is not innate but should be taught, how well are educational institutions prepared to teach such a subject? How to train, if to teach it's necessary to have learned before? Is the issue of teacher training being taken seriously by most institutions? Is there a bet on valuing human resources or a preference for acquiring technological resources without adequate preparation of who should use them critically?

The teaching-learning process on critical thinking should be motivating, based on students' real experiences, applicable and useful in the various spheres of their academic, personal and professional life. Is this process naturally seen for teachers and students as advantageous or rather as an educational imposition that must be met?

The use of active teaching methodologies such as PBL is recommended for the development of this and other skills. To what extent do teachers use that or other pedagogical strategies that challenge the student to be the protagonist of his learning, reflecting, building his knowledge through interessant exercises of analysis, synthesis, argumentation, logical reasoning, individually, in groups and communicating with the others?

Some self-assessment results on the development of a number of important skills reveal that critical thinking from a student perspective, although a fairly well-developed competency in higher education, is not the first in the ranking of their choices. It will be appropriate to ask if pedagogical work is being done in the most suitable way, for example clearly showing learners the advantages of more frequent and better use of critical thinking? On the other hand, are they being provided with the best conditions to demonstrate that they are competent in this matter? Are they getting the proper feedback on their learning progress?

4 CONCLUSIONS

Finally, the conclusions draw attention to a necessary collaborative work that considers the multiple variables under study, from educational agents, official and professional associations that can enable an improvement of the existing reality.

Although the involvement of all these actors is crucial, we believe that the starting point should come from the Ministries of Education that must change their education policies so that critical thinking and decision-making have a more explicit and systematic practical approach. Indeed, if

these and other soft skills of the 21st century are associated with the desired profile of Bologna graduates, they should be given more time and more learning space for this subject and preferably as early as possible. In particular, in higher education, with a visible and continuous presence in the course plans of all scientific areas, as this is a transversal competence that needs to be stimulated and worked on, isolated and or together with others, along the academic path and later, in the perspective of lifelong learning.

The need for a general awareness and institutional commitment is crucial. Frequently, mental changes are the most difficult and it is necessary to make an effort to internalize a new way of being in teaching. Sensitize the education community – school managers, teachers and students - about the advantages of critical thinking, with a practical and motivating approach which will be an essential action for adherence and openness to learning. And to promote personalized teaching, taking into account the characteristics and interests of the students, always making an approach to everyday life and demonstrating the usefulness that critical thinking is essential for good decision making, so useful in academic, personal and professional contexts.

Certainly, better economic conditions must be mobilized - smaller classes, teacher training, more institutional training for the whole education community, testimonials from professionals, more sharing of good practices. Institutional commitment is crucial and may also include marketing actions focusing on the topic in order to increase its visibility and importance.

Making the necessary changes or adopting the transformative attitudes regarding a subject that is unfortunately diluted in sporadic pedagogical approaches and betting effectively on academic training can be the key to achieve, with success, a desirable transition from the academia to the professional context: good thinking students in the academic world will certainly be critical workers and prepared for a fit and responsible decision-making process, in the labour market and in the information society.

REFERENCES

[1] AMA (American Management Society), *Critical Skills Survey*, 2012. Retrieved from https://playbook.amanet.org/wp-content/uploads/2013/03/2012-Critical-Skills-Survey-pdf.pdf

[2] ALA (American Library Association), *Standards for the 21st century Learner*, 2009. Retrieved from https://www.epsnj.org/site/handlers/filedownload.ashx?moduleinstanceid=7770&dataid=32216&FileName=AASL%2021ST%20C%20LEARNER.pdf

[3] ISTE (International Society for Technology in Education), *National Educational Technology Standards for Students (NETS-S)*, 2007. Retrieved from https://id.iste.org/docs/pdfs/20-14_ISTE_Standards-S_PDF.pdf

[4] NEA (National Education Association), *Preparing 21st century students for a global society: An educator's guide to "the four Cs",* 2012. Retrieved from http://www.nea.org/assets/docs/A-Guide-to-Four-Cs.pdf

[5] World Economic Forum, *The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution*, 2016. Retrieved from http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf

[6] UNESCO, *Rethinking education, Towards a global common good?,* 2015. Retrieved from http://unesdoc.unesco.org/images/0023/002325/232555e.pdf

[7] The World Bank Group, *Learning to realize education's promise*, 2018. Retrieved from https://www.skillsforemployment.org/KSP/en/Details/index.htm?dn=WCMSTEST4_193500

[8] A. Franco, R. M. Vieira, C. Saiz, "O pensamento crítico: as mudanças necessárias no contexto universitário", *Revista de Estudios e Investigación en Psicología y Educación,* 2017, vol. Extr., nº. 07, pp.12-16. Retrieved from http://revistas.udc.es/index.php/reipe/article/view/reipe.2017.0.07.2233/pdf

[9] A. Franco, R. M. Vieira, C. Tenreiro-Vieira, "Educating for critical thinking in university: The criticality of critical thinking in education and everyday life", *ESSACHESS. Journal for Communication Studies*, 2018, vol. 11, nº. 2(22), pp. 131-144. Retrieved from http://www.essachess.com/index.php/jcs/article/view/429/463

[10] C. Saiz, S. Rivas, "Pensamiento crítico y aprendizaje basado en problemas cotidianos*", Revista de Docencia Universitaria*, 2012, vol.10, nº. 3, pp. 325-346. Retrieved from https://polipapers.upv.es/index.php/REDU/article/view/6026/6091

[11] S. Rivas, C. Saiz, "¿Perduran en el tiempo las habilidades de pensamiento critico adquiridas mediante instrucción?", in *Pensamento Crítico na Educação: Desafios Atuais*. (C. Dominguez et al., eds.), pp. 137-144, Vila Real: UTAD, 2015. Retrieved from http://www.pensamiento-critico.com/archivos/ebookutad137.pdf

[12] C. Saiz, S. Rivas, "New teaching techniques to improve critical thinking. The Diaprove methodology", *Educational Research Quarterly,* 2016, vol. *40, nº* 1, pp. 3-36. Retrieved from http://www.pensamiento-critico.com/archivos/diaproveERQ160307web.pdf

[13] A. Franco, L. Almeida, "Critical thinking in college: differential analysis by academic year and scientific area", in *Pensamento Crítico na Educação: Desafios Atuais*. (C. Dominguez et al., eds.), pp. 25-30, Vila Real: UTAD, 2015. Retrieved from http://repositorium.sdum.uminho.pt/bitstream/1822/36484/1/2015_Franco%20%26%20Almeida%20%282015%29.pdf

[14] E. Veiga, H. Gil, E. Cardoso, A. Jácomo, "A perspetiva dos alunos sobre um projeto de desenvolvimento do pensamento crítico no ensino superior", *Revista Lusófona de Educação,* 2016, vol. 32, pp. 109-121. Retrieved from https://revistas.ulusofona.pt/index.php/rleducacao/article/view/5518

[15] BRAGA, Inês - *A LITERACIA DA INFORMAÇÃO NO ENSINO POLITÉCNICO: competências e práticas numa Escola Superior* [Doctoral Dissertation]. Porto: Faculdade de Letras do Porto, 2014. Retrieved from WWW: https://repositorio-aberto.up.pt/handle/10216/76099