

# Critical Thinking and the Impact on University Education for Sustainable Development

Ricardo Chaname-Chira<sup>1</sup>, Dyanne Santisteban-Chevez<sup>2</sup>,  
Kelly Maricela Reynoso Tafur<sup>3</sup>, Peter Garcia Villalobos<sup>4</sup>, Walter Campos-Ugaz<sup>5</sup>,  
Lourdes Ivonne del Carmen Alcaide-Aranda<sup>6</sup> and Dante Rafael Aguinaga Villegas<sup>7</sup>

<sup>1</sup>Universidad Tecnológica del Perú, Perú

<sup>2</sup>Universidad Tecnológica del Perú, Perú

<sup>3</sup>Universidad Tecnológica del Perú, Perú

<sup>4</sup>Universidad Tecnológica del Perú, Perú

<sup>5</sup>Universidad Nacional Pedro Ruíz Gallo, Perú

<sup>6</sup>Universidad Nacional Mayor de San Marcos, Perú

<sup>7</sup>Universidad Nacional Mayor de San Marcos, Perú

E-mail: <sup>1</sup>C15312@utp.edu.pe, <sup>2</sup>C16907@utp.edu.pe, <sup>3</sup>C16724@utp.edu.pe, <sup>4</sup>C21951@utp.edu.pe,

<sup>5</sup>naneniwalter@gmail.com, <sup>6</sup>alcaidea@unmsm.edu.pe, <sup>7</sup>daguinagav@unmsm.edu.pe

ORCID: <sup>1</sup><https://orcid.org/0000-0001-6410-5192>, <sup>2</sup><https://orcid.org/0000-0002-8366-0762>,

<sup>3</sup><https://orcid.org/0000-0003-2326-5987>, <sup>4</sup><https://orcid.org/0000-0002-8944-0904>,

<sup>5</sup><https://orcid.org/0000-0002-1186-5494>, <sup>6</sup><https://orcid.org/0000-0003-0304-8344>,

<sup>7</sup><https://orcid.org/0000-0001-5166-0509>

(Received 14 May 2024; Revised 30 June 2024, Accepted 24 July 2024; Available online 30 September 2024)

**Abstract** - Man by nature is a homo pensantis. This means that he has the capacity to analyze, synthesize, deduce, etc. However, we must question how educational institutions strengthen critical thinking (CP). Therefore, the purpose of this study was to analyze its level in academic tasks assigned in the classroom context based on active methodologies as an integral element of a quality and sustainable education. The methodology was based on a documentary review with a qualitative and bibliometric approach. The corpus consisted of thirty-one articles extracted from the Scopus database. Likewise, the Prisma Technique was used for the exclusion and inclusion of the documents consulted. The writings are from the years 2020 to 2023. The results showed that CP is a limitation for the student, since its exercise demands the use of complex cognitive skills such as analysis, interpretation, inference, evaluation, etc. It was concluded that PC is necessary in the classroom context, since it is important to induce the search for contradictions and assumptions and to question a reasoning accepted as truth, becoming an indispensable requirement for higher education to provide training tools to students to respond to current sustainable needs.

**Keywords:** University Students, Critical Thinking, Sustainability, Strategy, Assessment, Evaluation

## I. INTRODUCTION

The changes derived from globalization and technology have led to the transformation of human activities. In the educational and pedagogical fields, it guides actions related to the development of certain competencies: teamwork, proactivity, creativity and innovation, communication, critical thinking (CP), adaptability, leadership, etc. One of them takes on greater importance in the integral development

of the student: critical thinking - thinking and acting critically with the learning acquired at school (Sulochana Neranjani, 2020). This is born from the dissatisfaction with respect to traditional teaching and memorization of concepts in the different disciplinary fields.

The central objective of education is the development of CP, since it provides students with elementary skills, such as analyzing, evaluating and solving problems in a reflective manner (Llopiz-Guerra et al., 2024). In order to foster this, the relevance of active methodologies is highlighted, since they promote self-learning and self-regulation (Garcés-Fuenmayor et al., 2023).

Strengthening it has a double value: social and pedagogical. The first, takes prominence due to the urgent need to counteract the political, economic, etc. crises inherent in contexts that demand the presence of individuals who are capable of intervening with criteria in the search for solutions to these disagreements. The second considers the relevance of education and the development of PC to form responsible citizens who guarantee a democratic society that seeks the common Good (Udayakumar et al., 2023). However, there are gaps with respect to understanding its impact, integrating it into the teaching of science in the various disciplines and analyzing its influence on learning autonomy based on the practice of active methodologies (Mathur et al., 2024).

There are several definitions of CP. First of all, it is a strategy that integrates cognitive and metacognitive skills (Boisvert, 2004). Secondly, it is the quality of thinking about an object,

event etc. that is subjected to intellectual patterning (Paul & Elder, 2005). Thirdly, it is the faculty to think and rethink about one's own thinking (Naessens, 2015). Finally, it is a way of being (attitude) that formulates reflections in the face of contextual events. (Arroyo, 2020). In summary, these definitions make it clear that PC requests a high intellectual act on the part of the subject; also, autonomy, skepticism and flexibility.

Limitations in students are diverse and are related to social, academic, and individual factors (Song et al., 2023; Martikainen et al., 2022; Alvarado et al., 2023). In the first place, we place cognitive biases. These are generated from a lack of experience, critical awareness and knowledge about the subject. As a result, they prevent a critical evaluation of the information. Secondly, we identify lack of experience (Oroujlou & Sadeghi, 2022). This arises from not having had the opportunity to critically take on concrete situations. Thirdly, we recognize the lack of communication skills. (Soysal & Soysal, 2023; Barzola et al., 2020; Nguyen & Nguyen, 2020). This limits the ability to share and discuss ideas, while developing more experienced critical thinking. In fourth place, we find a lack of motivation (Álvarez-Huerta et al., 2022). If one is not motivated to learn or to develop critical skills, one may have limitations or barriers to face intellectual challenges. Lastly, the lack of resources can be distinguished (Meletiadiou, 2022; Galán-Casado et al., 2020; López-Bajo et al., 2021).

Proposals for teaching CP are proposed. On the one hand, active methodologies are implemented. These are incorporated into the educational task such as PBL, collaborative learning (Arasu et al., 2024), etc., to foster CP and reflection in students (Song et al., 2023). On the other hand, they promote communication and participation. (Sytnik & Stopochkin, 2023). These are raised in the classroom through challenging activities that lead to the resolution of complex problems and critical skills in collaboration with peers (Doris et al., 2023). On the other hand, it incorporates didactic resources and materials (Martikainen et al., 2022). It makes use of critical texts, documentaries, films and case studies for the stimulation of reflection and discussion (Smeaton, 2023). Finally, they assume continuous evaluation and feedback (Martikainen et al., 2022). This allows them to identify areas for improvement and foster their academic growth.

Active methodologies encourage participation based on the processing and reflection of information. Through the use of these approaches (experiential learning, PBL and collaborative learning) (Uribe Hernández et al., 2023), learners have the opportunity to become directly involved and face difficult and complicated problems (Alvarez-Huerta et al., 2022). By actively participating in their education, students have the ability to analyze, evaluate and synthesize knowledge (Hammad, 2020). This helps them to understand concepts in greater depth, while questioning assumptions,

recognizing biases, and contributing original ideas (Meletiadiou, 2022).

In addition, it fosters responsibility and independence in the classroom (self-regulation of the class, a more active role is assumed). Galán-Casado et al., (2020); López-Bajo et al., (2021). When university students are stimulated to investigate, debate and work together to solve problems, they acquire metacognitive skills. They monitor their own thoughts, control their mental processes, and take into account their own biases and ideas.

Likewise, resources and tools are used for their teaching. Their use varies according to the needs of the students and the methodologies used.

First, it uses critical texts such as academic articles, documentaries, films, and case studies (Oroujlou & Sadeghi, 2022; Hidayati & Idris, 2020; Alvarado et al., 2023). The importance of its use lies in the stimulation of reflection and discussion based on the evaluation of evidence, the construction of arguments and the identification of biases.

Secondly, analysis tools are used in mathematics disciplines; among them flow charts, Venn diagrams, etc. (Catarino & Vasco, 2021). The goal of these is to identify patterns and trends in the information, which are critically evaluated.

Third, collaboration software is available, particularly Google Docs or Microsoft Teams. These allow you to collaborate on projects, share ideas, and discuss the development of the assigned (Velásquez et al., 2023).

Fourth, mobile applications are available (Asniza et al., 2021). (Asniza et al., 2021). These include playful tools, analysis tools, and applications that promote discussion and reflection (Patiño et al., 2023; Castillo et al., 2023).

Finally, workshops and seminars are used. Specific topics are addressed for the construction of arguments, the identification of biases, and the evaluation of evidence through the socialization of ideas and digital learning environments (Aljedayah et al., 2023; Mendoza et al., 2020) and the use of social networks (Garcés-Fuenmayor et al., 2023).

This topic has been addressed because of its relevance in the educational field and within the framework of the competency-based approach. The purpose of education is to awaken, cultivate and perfect competencies up to the critical level, because it helps to strengthen their intellect, their emancipation and the predominance of aptitudes and skills. And it is that the University invites not to lose its identity of leading a change in society, it must prepare capable professionals. To commit themselves to the world in which they live, putting their knowledge at the service of society as a whole.

In view of the above, we sought to know the level of research on the basis of studies carried out, 1) list the publications on critical thinking in the field of education in the Scopus databases; 2) evaluate the quality of the studies through Scimago Journal & Country Rank; 3) synthesize the results of the selected papers on this topic, which allows formulating suggestions and directions for future research; 4) identify research on CP for sustainable development.

## II. METHODOLOGY

Systematic review (SR) is essential for any data-driven discipline, as it provides the best information and influences decisions. The objective is to recognize the available evidence, assess the validity of this information, and list it (Salcido et al., 2021).

A SR about CP in the classroom context has been carried out. The moments of the methodological route were oriented towards inquiry, identification and deepening. Scopus was used to identify the units of analysis. These were included between the years 2020 - 2023. Scopus offers five sorting options: date, relevance, etc. (Cañedo et al., 2010).

The Unesco Social Sciences Thesaurus was used to extract the following descriptors: "university students", "critical thinking", "constraints", "strategy" and "evaluation". These were identified with the help of Boolean operators (and and or). The collected files were then exported to the Mendeley manager. Thanks to this program, it is possible to store, organize and edit bibliographic references from various sources. It is also possible to manage and annotate documents related to these references (Bernal et al., 20). (Bernal et al., 2022).

The basic review question was: How is critical thinking worked on in the classroom context? Specific questions arise: What limitations do students present? What strategies, resources and tools are used? How is it evaluated?

Similarly, the review question was formulated under the PICOC research approach in order to define the main aspects of meta-analysis. This approach is based on the elaboration of questions that make it possible to precisely identify the five essential elements of the information to be obtained (see Table I).

TABLE I PICOC QUESTIONS - COMPONENTS

Acronym	Component	Description
P	Problem	Students
I	Intervention	Active methodology
C	Comparison	---
O	Result	Critical thinking
C	Context	Aulico

Table I illustrates the description (P) of the main problem of the study, i.e., the events that affect university students in terms of their ability to think constructively. The component (I) refers to the proposals or solutions elaborated to solve the problem; that is, the active methodology for its development. The expected result (O) of the intervention, in this case, was the increase in PC. Finally, for component (C), the classroom context was considered.

Also, with the support of the Preferred Reporting Items for Systematic Review and Meta Analyses (PRISMA) technique - is a framework for reviewing and evaluating the literature to be incorporated in this study (Barquero, 2022) - articles that had no affinity with our study were excluded. The date of publication was a discard criterion. Likewise, the temporal aspect (2020 - 2023), thematic, refereed publications and full text; those of inclusion.

A total of 135 documents were preselected, of which 31 were selected as the corpus of this research. Excel was used to systematize the content of each of them according to author, year, title, doi, journal, objectives, type of study, sample, instruments, main contributions.

## III. RESULTS

When we started the general search for documents in Scopus on "critical thinking" we found a significant number (29, 979). This number is attributed to the need to investigate and publish results on its importance. Between 1974 and 2023, 603 types of documents have been published. Of these, 78% correspond to articles (472). The interest in their dissemination lies in exposing the results of rigorous studies that are submitted to peer review, which determines their level of quality and accuracy.

For the statistical analysis, the years 2010 to 2023 have been selected. In this period, there are 550 publications. The distribution of the number of documents reveals a fluctuating dynamic in their production. That is, the average per year is 42 files. Thus, 2023 is the period with the highest number of publications (90 in total - equivalent to 16%). It is in this year that researchers are interested in inquiring about the relevance of the progress of PC skills in tertiary education and also recognize it as an essential component in the holistic formation of the student.

Likewise, there is evidence of a decrease in interest in this topic. In the years 2022, 85 documents were published, representing 15%; in 2021 we have (10%); 2014, 13 (2%); 2013, 17 (3%); 2012, 14 (3%); and 2010, 16 (3%). These data show a slight decrease in these publications (figure 1).

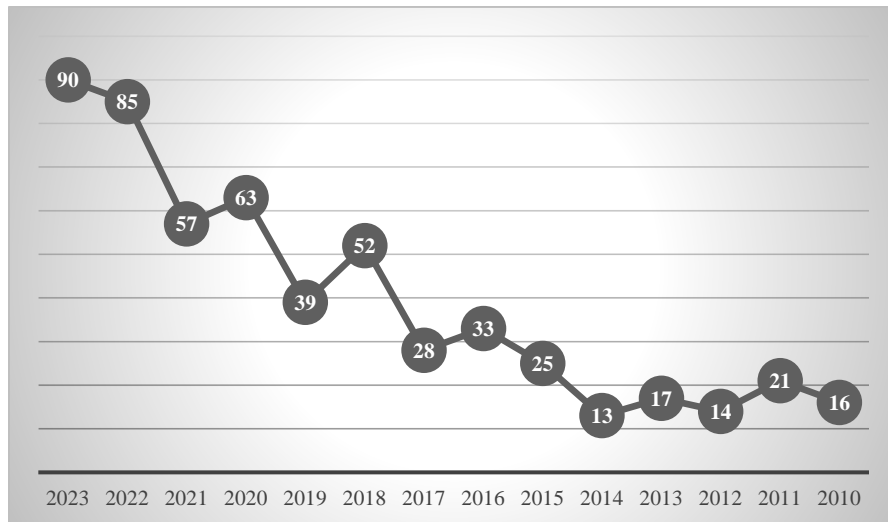


Fig. 1 Documents by Year

Likewise, 13% are conference papers (79), 3.5% are book chapters (25), 2% are reviews (15), 1% are books and conference reviews (6), 0.3% are editorials (2) and 0.2% are notes (1). These papers are in the minority, as they generate doubts about their validity due to their lack of rigor in peer

review or lack depth and complexity in their significant contribution to the advancement of knowledge; that is, they do not meet the exacting standards of the academic community (figure 2).

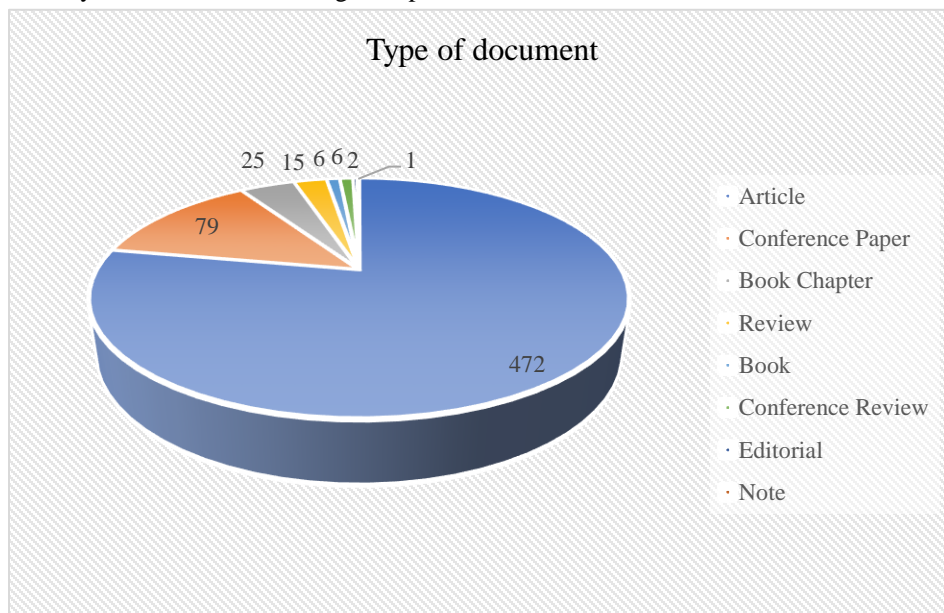


Fig. 2 Type of Document

The United States is the leading country with the highest number of disclosures with a total of 74 disclosures (d.). This shows that it is one of the territories with the most research and scientific development. This is corroborated by the Scimago Journal Rrank indicator, where it is in first place, with 15,188,630 documents and 467,519,124 citations (c.). Countries such as Spain (56 d.) is in the eleventh place with 1 851 420 papers and 41 231 830 citations, China (33 d.) is

in second place with 9 239 029 manuscripts and 118 957 559 c., Russian (33 d.) is in twelfth place with 1 592 214 files and 13 720 248 c., Australia (31 d.) ranks tenth with 1 877 629 records and 50 051 440 c., Turkey (27 d.) ranks nineteenth with 838 530 articles and 11 280 898 c. and Malaysia (25 d.) ranks twenty-sixth with 454 998 documents and 5 549 924 c. close the top of nations involved in scientific production (figure 3).

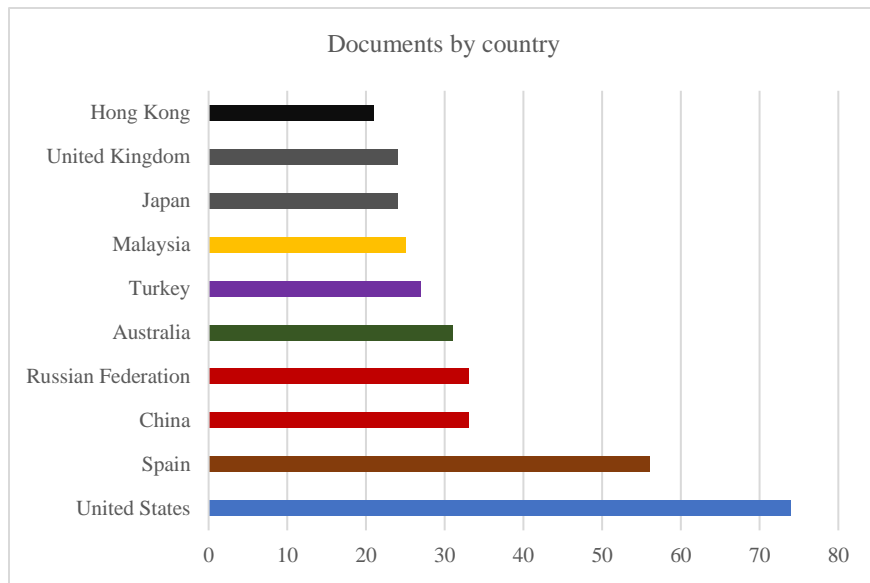


Fig. 3 Documents by Country

The results of the analysis by subject area show that the distribution of publications in the various specialized disciplines varies. Social Sciences (452), in particular, is the field with the most articles, followed by Computer Science (93) and Psychology (91). As can be seen, the methodologies and topics in social science research are crucial, as they include social, cultural and political aspects. However, there

are disciplines that show interest in the importance and advancement of science: psychology, computer science, engineering, business, medicine, etc. This range of thematic coverage generates collaboration to propose strategies that allow the development of CP based on innovative and interdisciplinary contributions of modern knowledge (figure 4).

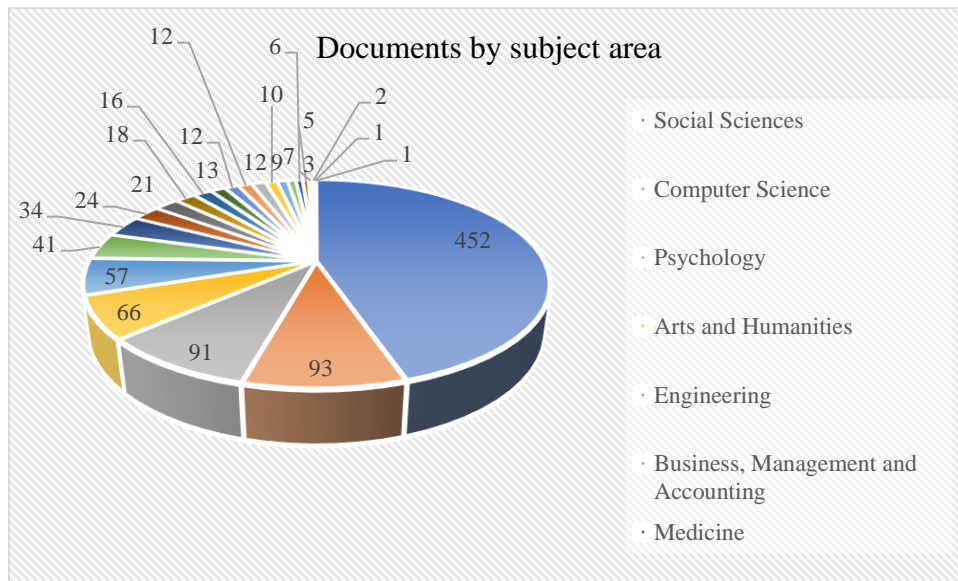


Fig. 4 Documents by Subject Area

However, Boolean operators were used for their limitation, which contributed to obtain the following results (Table II).

TABLE II KEYWORDS USED IN THE SEARCH

Database	General search	Result	Advanced search	Result
Scopus	critical thinking	29,979	(TITLE-ABS-KEY (university students OR students) AND TITLE-ABS-KEY (critical thinking OR complex thinking) AND TITLE-ABS-KEY (limitations OR difficulties) AND TITLE-ABS-KEY (strategy OR method) AND TITLE-ABS-KEY (assessment OR qualification))	135

With the help of the Prisma Technique, the respective filter was executed based on the following criteria: research eliminated by temporality (69), by title and abstract (23), by full text evaluation (8), by different language (1), not an article (2). A total of 31 documents were obtained. The following table lists the selected documents.

The multidimensionality and complexity lead to the use of different tools for its evaluation. From providing information from scientific or social contexts, students must process,

analyze, evaluate, reflect and make decisions. Therefore, it is necessary to use tools and strategies that evaluate it effectively.

What is striking in this systematic review is the diversity of instruments used to evaluate the level of critical thinking.

Seven studies specify the use of written production, survey and questionnaire. Three documents register the use of pre- and post-test; two, rubric. Likewise, the use of video recording, intelligence test, didactic intervention and creative self-efficacy are specified (Figure 5).

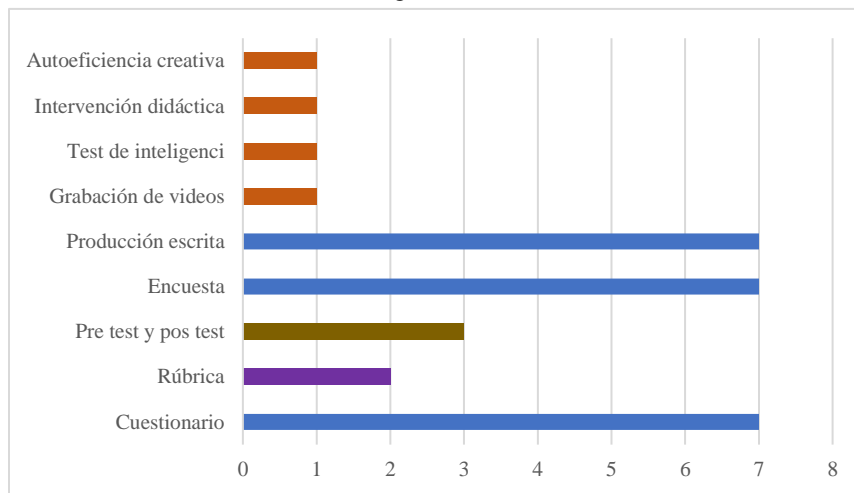


Fig. 5 Instruments

The Scimago Journal & Country Rank was used to evaluate the quality of the studies, since it objectively provides a measure of the prestige of academic journals. For this purpose, it uses the quantity and quality of citations.

TABLE III EVALUATION OF THE QUALITY OF THE STUDIES

Nº	Journal	Scimago Journal & Country Rank
1	Obrazovanie i Nauka	Q3
2	Journal of Educational Research	Q2
3	Education and Humanism	--
4	Contemporary Educational Technology	Q1
5	Teaching English Language	--
6	Health Education and Behavior	Q1
7	ECNU Review of Education	Q2
8	Education Sciences	Q2
9	Journal of Higher Education Theory and Practice	Q4
10	Thinking Skills and Creativity	Q1
11	BMC Medical Education	Q1
12	Production and Clean	Q4
13	Eureka Magazine	Q3
14	International Journal of Evaluation and Research in Education	Q3
15	International Journal of Emerging Technology and Advanced Engineering	Q4
16	Interchange	Q2
17	IAFOR Journal of Education	Q3
18	Social Prism	Q3
19	European Journal of Contemporary Education	Q2
20	Journal of Turkish Science Education	Q2
21	Open Education Studies	Q2
22	Panta Rei	Q1
23	Philological Class	--
24	Cuban Journal of Higher Medical Education	Q4
25	Sustainability	Q1
26	International Journal of Instruction	Q2
27	International Journal of Scientific and Technology Research	--
28	Universal Journal of Educational Research	--
29	Spanish Journal of Pedagogy	Q2

The table III shows that six articles have been published in journals in **Q1** (Contemporary Educational Technology, Health Education and Behavior, Thinking Skills and Creativity, BMC Medical Education, Panta Rei, Sustainability). Also, nine in **Q2** (Revista de Investigación Educativa, ECNU Review of Education, Education Sciences, Interchange, European Journal of Contemporary Education, European Journal of Contemporary Education, Open Education Studies, International Journal of Instruction, Revista Española de Pedagogía); five in **Q3** (Obrazovanie i Nauka, Revista Eureka, International Journal of Evaluation and Research in Education, IAFOR Journal of Education, Prisma Social) and four in **Q4** (Journal of Higher Education Theory and Practice, Produccion y Limpia, International Journal of Emerging Technology and Advanced Engineering, Revista Cubana de Educación Médica Superior).

Regarding the objective that links the use of the PC in the university context as a way of learning, it is observed that there are still few studies that mention sustainable education in higher education, evidencing the importance of the PC in the formation of university classrooms, constituting the necessary change to respond to social challenges that predispose a positive response to sustainability.

#### IV. DISCUSSION

The topic of critical thinking involves various disciplines. Therefore, the impact generated by a publication that contributes to its understanding and evaluation is fundamental, as it contributes to knowledge and recognition. This is reflected by the number of citations they receive, thus demonstrating their usefulness for other research.

A research career is achieved by publishing in high impact journals - the main means of dissemination - as this increases the veracity of the information and thus reaches a wide and specialized audience. Their choice is decisive, since their reputation and the receptive public will prescribe the rigor and acceptance of the research.

Therefore, the impact index and the ranking of journals should be considered. Thus we have that the publications of (Patiño et al., 2023; Smeaton, 2023; Álvarez-Huerta et al., 2022; Alsuraihi, 2022; López-Bajo et al., 2021; Galán-Casado et al., 2020) are located in Q1 in Scimago Journal & Country Rank.

Likewise, research (Alvarado et al., 2023; Soysal & Soysal, 2023; Song et al., 2023; Martikainen et al., 2022; Suarez-Brito et al., 2022; Asniza et al., 2021; Catarino & Vasco, 2021; Hidayati & Idris, 2020; Santana-Vega et al., 2020) are in Q2.

Also, Aljedayah et al., (2023); Cobo-Huesa et al., (2022); Ginting et al., (2022); Meletiadou, (2022); Polo et al., (2022) are located in Q3. Finally, Velasquez et al., (2023); Coacalla et al., (2022); Ginting et al., (2022); Barzola et al., (2020) are located in Q4.

These researchers have maximized the impact and relevance of their research in the scientific arena due to the meticulous selection of the journal and the following of publication standards and criteria.

The findings on the development of PC in the classroom context indicate that they are strengthened in collaborative activities (Ginting et al., 2022). It is there the importance of making use of active methodologies in this space, as it encourages active interaction, assertive and effective communication and collective knowledge building (Spisiakova et al., 2021; Pegalajar et al., 2022). From challenging assignments on complex concepts, meaningful social learning is achieved, as viewpoints are shared, intellectual discourse is engaged, and collaborative knowledge of intricate ideas is developed. In addition, students stimulate conceptual learning in practical situations. (Alsuraihi, 2022). That is, they develop a holistic and deep vision of the complex concept from the use of theory and praxis.

On the other hand, it was mentioned earlier that the evaluation of PC invites the use of various instruments. For example, argument analysis is used in discussion and debate. (Soysal & Soysal, 2023). Its practice involves verifying and validating the premises, their logical coherence, their internal consistency and the soundness of their conclusions in their interventions. Likewise, it is used in the resolution of complex problems (Huaman-Romaní et al., 2022).

The application of knowledge in concrete contexts, informed decision making and the identification of effective solutions are required for the resolution of practical exercises. Also, written evaluation is used (Barzola et al., 2020; Nguyen &

Nguyen, 2020). Essays and reports are common tools to assess critical thinking, as they allow expressing ideas and arguing points of view.

Lastly, there are the evaluation rubrics (Cobo-Huesa et al., 2022). To measure the cognitive and analytical skills of students, these provide clear and objective criteria. They also include indicators such as the ability, clarity of reasoning, originality of ideas, depth of analysis to solve complex problems.

There is a close relationship between critical and creative problem solving and the implementation of active methodologies. In other words, for authentic problem solving, the use of critical and creative thinking is of interest, since patterns are identified, situations are analyzed from different perspectives, hypotheses are formulated and decisions are made. (Suarez-Brito et al., 2022).

Likewise, creativity is fostered by making use of innovative ideas and the search for unconventional solutions. Tasks or activities that demand the use of thinking (lateral, divergent or critical) expand the ability to think creatively and propose innovative solutions to complex problems. (Polo et al., 2022).

There are significant differences between participation in active and traditional methodologies. From learning situations that require the application of knowledge in real contexts, active methodologies contribute to the development of a more insightful and reflective critical thinking (Coacalla et al., 2022).

However, traditional methodologies tend to focus on the passive transmission of information, generating a superficial understanding of concepts and a lower capacity to critically analyze the information. In other words, they limit opportunities for reflection, debate and practical application of knowledge. As a result, there is a lack of skills needed to evaluate objectively, question assumptions and generate innovative ideas.

## V. CONCLUSIONS

The PC in the classroom context has been the subject of study. Its importance lies in the development of cognitive and analytical skills and it is essential to face the constant changes and challenges of a globalized world.

The need to strengthen it through active methodologies and effective didactic strategies in real contexts is highlighted. It is noted that its development in students allows them to acquire essential skills to solve problems effectively and equitably, and benefits them in their learning process.

The teaching task takes center stage for its promotion in the pedagogical work, since its use and application allows them to make informed decisions based on a deep and reflective analysis of the information in the students. Studies carried out in different contexts provide evidence on the effectiveness of

active pedagogical strategies to promote it in university environments.

This systematic review has revealed that CP can be approached in various disciplines of knowledge and therefore highlights the importance of integrating it in a cross-cutting manner in all careers and subjects. Moreover, with the help of effective tools it can be promoted. In summary, the findings highlight its relevance in education, because it enhances analysis, choice of information, problem solving, rational choice, making informed judgments, independent opinion, reflecting on social issues based on argumentation and counter-argumentation, etc. It is essential to implement innovative strategies that promote its development in the academic and integral formation of students.

The university becomes a fundamental actor to achieve welfare and sustainable development becoming an important factor for future generations. University institutions, from their different areas; research, innovation, teaching, must implement actions that lead the student to use the PC as the ability to analyze and evaluate the consistency of reasoning in the classroom. Social Responsibility and the university become a commitment to society that seeks to have Higher Education capable of addressing the challenges of the 2030 Agenda.

## REFERENCES

- [1] Aljedayah, K. S., Al-Duwairi, A. M., Al-Momani, M., Al-Mzary, M. M., Khataybeh, G. S., & Al-Abed, A. S. (2023). University students' perception of the role of educational digital incentives in motivating academic engagement in professional education. *Education and Science*, 25(6), 126-148. <https://doi.org/10.17853/1994-5639-2023-6-126-148>
- [2] Alsuraihi, A. A. (2022). The effect of implementing mind maps for online learning and assessment on students during COVID-19 pandemic: a cross sectional study. *BMC Medical Education*, 22(1). <https://doi.org/10.1186/s12909-022-03211-2>.
- [3] Alvarado, C., Saadati, F., & Millán, E. A. (2023). Developing student writing. The potential of a collaborative problem-solving methodology. *Revista de Investigación Educativa*, 41(1), 143-166. <https://doi.org/10.6018/rie.517231>
- [4] Álvarez-Huerta, P., Muela, A., & Larrea, I. (2022). Disposition toward critical thinking and creative confidence beliefs in higher education students: The mediating role of openness to diversity and challenge. *Thinking Skills and Creativity*, 43. <https://doi.org/10.1016/j.tsc.2022.101003>
- [5] Arasu, R., Chitra, B., Anantha, R. A., Rajani, B., Stephen, A. L., & Priya, S. (2024). An E-learning Tools Acceptance System for Higher Education Institutions in Developing Countries. *Journal of Internet Services and Information Security*, 14(3), 371-379.
- [6] Arroyo, J. E. (2020). Critical thinking: central element in the processes of learning and argumentation in students of the Universidad del Pacífico. In D. Cuenca, Y.; Herrera, S. and Riascos (Ed.), *Language, argumentation and reflection. Aproximación a procesos de lectoescritura en Buenaventura* (pp. 109-124). Editorial Universidad del Pacífico.
- [7] Asniza, I. N., Zuraidah, M. O. S., Baharuddin, A. R. M., Zuhair, Z. M., & Nooraida, Y. (2021). Online Game-Based Learning Using Kahoot! to Enhance Pre-University Students' Active Learning: A Students' Perception in Biology Classroom. *Journal of Turkish Science Education*, 18(1), 145-160. <https://doi.org/10.36681/tused.2021.57>
- [8] Barquero, W. (2022). Prism analysis as a methodology for systematic review: a general approach. *Revista Saúde Em Redes*, 8, 339-360. <https://doi.org/10.18310/2446-4813.2022v8nsup1p339-360>
- [9] Barzola, V. M., Bolívar, O. Ee., & Navarrete, Y. (2020). Incidence of reading comprehension on research skills in higher education students. *Higher Medical Education*, 34(4).
- [10] Bernal, J. C., Nebot-Díaz, E., & Madrid, J. A. (2022). Mendeley, the manager of bibliographic references and its application in the teaching of Conservation and Restoration of Cultural Heritage, seen from a gender mainstreaming perspective. Mendeley, the manager of bibliographic. *VIII Congreso de Innovación Educativa y Docencia En Red*, 360-368. <https://doi.org/10.4995/INRED2022.2022.15900>
- [11] Boisvert, J. (2004). *The formation of critical thinking. Theory and practice*. Fondo de Cultura Económica.
- [12] Cañedo, R., Rodríguez, R., & Montejó, M. (2010). Scopus: the largest database of peer-reviewed scientific literature available to underdeveloped countries Scopus: The largest database of peer-reviewed scientific literature available to underdeveloped countries. *Revista Cubana de ACIMED*, 21(3), 270-282.
- [13] Catarino, P., & Vasco, P. (2021). Teaching Linear Algebra in Engineering Courses Using Critical Thinking. *Open Education Studies*, 3(1), 76-83. <https://doi.org/10.1515/edu-2020-0141>
- [14] Coacalla Castillo, C. E., Gutiérrez Gayoso, M., Ríos Navío, J., & Gutiérrez De Oporto, A. C. (2022). Systemic Thinking in the Teaching of Ecoefficiency in Universities. *Producción + Limpia*, 17(1), 6-19. <https://doi.org/10.22507/pml.v17n1a1>.
- [15] Cobo-Huesa, C., Abril, A. M., & Ariza, M. R. (2022). Pedagogical content knowledge for teaching of nature of science and critical thinking in initial primary teacher education. *Eureka Journal*, 19(3), 360201-360215. [https://doi.org/10.25267/Rev\\_Eureka\\_ensen\\_divulg\\_cienc.2022.v19.i3.3602](https://doi.org/10.25267/Rev_Eureka_ensen_divulg_cienc.2022.v19.i3.3602)
- [16] Doris, F. G., Oscar, G. G. Z., Juan, S. T., Silvia, J. A. V., Miguel, A. S., & Ronald, M. H. (2023). An Ensemble-based Machine Learning Model for Investigating Children Interaction with Robots in Childhood Education. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications*, 14(1), 60-68.
- [17] Galán-Casado, D., Moraleda, A., Martínez-Martí, M. L., & Pérez-Nieto, M. Á. (2020). Sustainable environments in education: Results on the effects of the new environments in learning processes of university students. *Sustainability*, 12(7), 2668. <https://doi.org/10.3390/su12072668>.
- [18] Garcés-Fuenmayor, J., García-Peña, E., Martínez-Garcés, J., & Escobar-Soto, R. (2023). Use of social media to promote critical thinking in university students during COVID-19. *Educacion y Humanismo*, 25(44), 17-34. <https://doi.org/10.17081/EDUHUM.25.44.5763>.
- [19] Ginting, D., Fahmi, F., Barella, Y., Hasbi, M., Kadnawi, K., Rojabi, A. R., & Zumrudiana, A. (2022). Students' perception on TPACK practices on online language classes in the midst of pandemic. *International Journal of Evaluation and Research in Education*, 11(4), 1995-2009. <https://doi.org/10.11591/ijere.v11i4.23014>.
- [20] Hammad, J. (2020). Communication Technology Affecting Education Acquisition for the Girl Child: Examining the Case of Chuluni District, Kitui County. *International Journal of Communication and Computer Technologies (IJCCTS)*, 8(2), 13-18.
- [21] Hidayati, N., & Idris, T. (2020). Students' habits of mind profiles of biology education department at public and private universities in Pekanbaru, Indonesia. *International Journal of Instruction*, 13(2), 407-418. <https://doi.org/10.29333/iji.2020.13228a>
- [22] Huaman-Romaní, Y. L., Juárez-Pulache, J. C., Romero, N. P., Carrillo-Riveros, E., & De la Cruz-Giron, K. A. (2022). University Students' Learning Experiences in the Virtual Environment. *International Journal of Emerging Technology and Advanced Engineering*, 12(5), 88-95. [https://doi.org/10.46338/ijetae0522\\_10](https://doi.org/10.46338/ijetae0522_10).
- [23] Llopiz-Guerra, K., Daline, U. R., Ronald, M. H., Valia, L. V. M., Jadira, D. R. J. N., Karla, R. S. (2024). Importance of Environmental Education in the Context of Natural Sustainability. *Natural and Engineering Sciences*, 9(1), 57-71.



- [24] López-Bajo, H., Martínez-Rodríguez, R., & Sánchez-Agustí, M. (2021). Development of historical consciousness. An intervention and evaluation proposal for Adult Education. *Panta Rei*, 15, 135-159. <https://doi.org/10.6018/pantarei.459241>.
- [25] Martikainen, J., Hujala, A., & Laulainen, S. (2022). Embodied Reflection of Images as an Arts-Based Research Method: Teaching Experiment in Higher Education. *Interchange*, 53(1), 75-97. <https://doi.org/10.1007/s10780-021-09449-x>.
- [26] Mathur, G., Nathani, N., Chauhan, A. S., Kushwah, S. V., & Quttainah, M. A. (2024). Students' Satisfaction and Learning: Assessment of Teaching-Learning Process in Knowledge Organization. *Indian Journal of Information Sources and Services*, 14(1), 1-8.
- [27] Meletiadiou, E. (2022). Using Educational Digital Storytelling to Enhance Multilingual Students' Writing Skills in Higher Education. *IAFOR Journal of Education: Technology in Education*, 10(2), 111-130.
- [28] Mendoza, J. R., Pamatmat, F., Daran, A., & Pamin, C. (2020). Employing Big6 Process For The Development Of Information Literacy Among College Students. *International Journal of Scientific & Technology Research*, 9(3), 901-905.
- [29] Naessens, H. (2015). Comparison between two authors of critical thinking: Jacques Boisvert and Richard Paul-Linda Elder. *Repositorio Institucional Universidad Autónoma de México*, 207-226.
- [30] Nguyen, T. S., & Nguyen, H. B. (2020). Unravelling Vietnamese students' critical thinking and its relationship with argumentative writing. *Universal Journal of Educational Research*, 8(11 B), 5972-5985. <https://doi.org/10.13189/ujer.2020.082233>.
- [31] Oroujlou, N., & Sadeghi, K. (2022). Effects of Explicit Teaching of Critical Thinking Strategies on EFL Learners' Reading Comprehension. *Teaching English Language*, 16(2), 1-29. <https://doi.org/10.22132/TEL.2022.142935>.
- [32] Patiño, A., Ramírez-Montoya, M. S., & Ibarra-Vazquez, G. (2023). Trends and research outcomes of technology-based interventions for complex thinking development in higher education: A review of scientific publications. *Contemporary Educational Technology*, 15(4), 1-25. <https://doi.org/https://doi.org/10.30935/cedtech/13416>
- [33] Paul, R., & Elder, L. (2005). *Standards, principles, performance indicators, and outcomes with a master rubric in critical thinking*.
- [34] Pegalajar, M. C., Burgos, A., & Martínez, E. (2022). Education for Sustainable Development and Social Responsibility: Keys to initial teacher training from a systematic review. *Revista de Investigación Educativa*, 40(2), 421-437. <https://doi.org/10.6018/rie.458301>
- [35] Polo, B. R., Ramírez, G., Hinojosa, C. A., & Castañeda, W. A. (2022). Transversal competences in the university educational context: a critical thinking from the principles of gamification. *Revista Prisma Social*, 38, 159-178.
- [36] Salcido, M. V., Vargas, A., Medina, N. A., Ramírez, F., García, M. O., Briseño, A. M., & Jiménez, J. M. (2021). Systematic review: the highest level of evidence Systematic review: the highest level of evidence. *Orthotips*, 17(4), 217-221. <https://doi.org/10.35366/102220>
- [37] Santana-Vega, L. E., Suárez-Perdomo, A., & Feliciano-García, L. (2020). Inquiry-based learning in the university context: A systematic review. *Revista Espanola de Pedagogia*, 78(277), 519-537. <https://doi.org/10.22550/REP78-3-2020-08>
- [38] Smeaton, A. F. (2023). Teaching Health Literacy and Digital Literacy Together at University Level: The FLOURISH Module. *Health Education and Behavior*, 50(5), 622-628. <https://doi.org/10.1177/10901981231163609>
- [39] Song, C., Park, J., & Kim, W. (2023). Nursing Students' Experiences of Havruta Learning in an Online Research Methodology Course. *Education Sciences*, 13(7), 1-11. <https://doi.org/10.3390/educsci13070634>.
- [40] Soysal, Y., & Soysal, S. (2023). Relationship Between a Teacher Educator's Questions and the Development of Prospective Teachers' Critical Thinking. *ECNU Review of Education*, 6(1), 105-140. <https://doi.org/10.1177/20965311221107028>
- [41] Spisiakova, A., Iermachkova, O., & Gajarsky, L. (2021). The use of media texts in Russian Language Teaching. *Philological Class*, 26(2), 245-253. <https://doi.org/10.51762/IFK-2021-26-02-21>.
- [42] Suarez-Brito, P., Baena-Rojas, J. J., López-Caudana, E. O., & Glasserman-Morales, L. D. (2022). Academic Literacy as a Component of Complex Thinking in Higher Education: A Scoping Review. *European Journal of Contemporary Education*, 11(3), 931-945. <https://doi.org/10.13187/ejced.2022.3.931>.
- [43] Sulochana Neranjani, E. (2020). Children's Literature: A Tool to Enrich Learning in the Elementary School. *Indian Journal of Information Sources and Services*, 10(2), 48-55.
- [44] Sytnik, I., & Stopochkin, A. (2023). A Model for the Selection of Active Learning While Taking into Account Modern Student Behavior Styles. *Education Sciences*, 13(7), 1-20. <https://doi.org/10.3390/educsci13070693>
- [45] Udayakumar, R., Muhammad, A. K., Sugumar, R., & Elankavi, R. (2023). Assessing Learning Behaviors Using Gaussian Hybrid Fuzzy Clustering (GHFC) in Special Education Classrooms. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications*, 14(1), 118-125.
- [46] Uribe Hernández, Y. C., Caballero Cifuentes, L. J., Núñez Lira, L. A., Luy-Montejo, C. A., Larico Apaza, Y. C., Acevedo Flores, J. E., & Vértiz Osoreo, J. J. (2023). Influence of SAS Software on the Learning of Statistics at the University Level. *Journal of Internet Services and Information Security*, 13(3), 178-190.
- [47] Velásquez, N. A., Meneses, M. E., Reyna, E. E., Zevallos, L. E., Díaz, S. A., & Valle, W. (2023). Associated Factors for Autonomous Learning in University Students From Northern Peruvian Cities. *Journal of Higher Education Theory and Practice*, 23(8), 269-275. <https://doi.org/10.33423/jhetp.v23i8.6112>