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Do the liberal arts make better scientific researchers?

Las artes liberales, ¿forman mejores investigadores científicos?

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ABSTRACT

This narrative review paper focuses on the relationship between the liberal arts and scientific inquiry. The liberal arts are disciplines focused on forming skills and knowledge that allow individuals to think logically, communicate effectively and maintain critical thinking of their environment. Throughout history, the liberal arts have proven to be efficient disciplines for the formation of knowledge, but how does the development of the liberal arts influence the development of scientific researchers and the dissemination of scientific information? The theoretical contributions of studies on research variables were considered for the planning of a research with a qualitative approach methodology, by means of a descriptive type of research, using the technique of bibliographic review. It is based on a perspective of the liberal arts centered on the interpretations of the Middle Ages, where these were considered in mythological stories that personified each of these arts as divine helpers with the function of developing man's knowledge. Likewise, the characteristics that focus on the formation of a scientific researcher to contrast the variables are presented. Among the most relevant results, it is established that the liberal arts and scientific research, despite appearing to be discordant systems, are two disciplines that complement each other adequately in the search for and development of knowledge and human development. The liberal arts positively influence the formation of academic researchers and the advancement of scientific research.

Keywords: Liberal arts, scientific popularization, literary study, scientific researcher, philology.

RESUMEN

El presente trabajo de revisión narrativa se centra en estudiar la relación entre las artes liberales y la investigación científica. Las artes liberales son disciplinas centradas en el formar habilidades y conocimientos que permiten a los individuos pensar de forma lógica, comunicarse de manera efectiva y mantener un pensamiento crítico de su entorno. A lo lago de la historia las artes liberales han demostrado ser diciplinas eficientes para la formación del conocimiento, pero ¿Cómo influye el desarrollo de las artes liberales en el desarrollo de investigadores científicos y en la difusión de información de este carácter? Se tuvieron en cuenta los aportes teóricos de estudios sobre las variables de investigación para la planificación de una investigación con metodología de enfoque cualitativo, mediante un tipo de investigación descriptiva, mediante la técnica de la revisión bibliográfica. Se parte de una perspectiva de las artes liberales centradas en las interpretaciones de la edad media, donde estas eran consideradas en relatos mitológicos que personificaban a cada una de estas artes como ayudantes divinos con la función de desarrollar el conocimiento del hombre. De igual manera, se presenta las características que se centran en la formación de un investigador científico para contrastar las variables. Entre los resultados más relevantes se establece que las artes liberales y la investigación científica, pese a parecer sistemas discordantes, son dos disciplinas que se complementan de manera adecuada en la búsqueda y desarrollo del conocimiento como del desarrollo humano. Las artes liberales influyen de manera positiva en la formación de investigadores académicos y en el avance de la investigación científica.

Palabras clave: Artes liberales, divulgación científica, estudio literario, investigador científico, filología.

INTRODUCTION

The liberal arts and scientific research are two seemingly distinct disciplines but complement each other perfectly in the pursuit of knowledge and human development. The liberal arts are characterized by their humanistic and multidisciplinary focus, aiming to develop in individuals' skills such as creativity, critical analysis, and effective communication. These disciplines include areas such as philosophy, literature, history, social sciences, and the arts, among others.

The work *The Universe of the Weddings of Mercury and Philology*, written by Martianus Capella in the mid-fifth century AD, uses a narrative style combining satire to draw the reader's attention and inform them about scientific knowledge. In this text, Mercury gifts Philology the trivium and quadrivium—seven books that systematize classical knowledge, possibly serving as an encyclopedic manual of the liberal arts. The following section studies these books through a semiotic system called tarot, given the significant similarity between the maidens and the court characters and major arcana according to the Marseille edition. Their symbols closely resemble those of the century in which Martianus Capella wrote, showing

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mystical tendencies, theurgical practices, and magical aspects. Additionally, printed versions of his work depict maidens with characteristics akin to tarot cards.

To approach the paradigm of the liberal arts from this moment, it is addressed from a mystical perspective, considering that the union of Philology and Mercury represents a path whose goal is love; therefore, education through the liberal arts is seen as a magical path of the heart. In an increasingly technological and globalized world, the liberal arts play a fundamental role in forming complete and critical individuals capable of adapting to changes and thinking creatively. These disciplines promote empathy, tolerance, and critical thinking, essential skills today.

On the other hand, scientific research focuses on answering specific questions through experimentation and data analysis. This discipline covers areas such as biology, physics, chemistry, mathematics, and engineering, among others. Scientific research is the driving force of progress and innovation today. Thanks to advancements in this area, discoveries have revolutionized medicine, technology, industry, and other fields. Without scientific research, we would not enjoy the technological and scientific advances we have today. This article explores the importance of these two areas of study and how their combination can lead to significant advances today.

METHODOLOGY

Type of Review

This study is based on a bibliographic documentary research approach, as the information was obtained through various documents. According to Figueroa et al. (2020): "The documentary research method is primarily used in qualitative studies. It involves an indirect approach to reality, based on secondary sources. Therefore, it accesses data available in written or visual sources generated by individuals, researchers, or institutions." (p.7)

This allows for data analysis to obtain logical results through documents that recount previously occurring events. In this sense, a narrative research approach is applied, which "assumes that reality is subjective, dynamic, and composed of various situations; it conducts a deep and reflective study of the inter and intra subjective meanings that compose the studied reality" (Faneite, 2023, p.85), aiming to address the relationship of study variables through the narrative of the researchers.

Research design

The research design employed was a narrative literature review (Green et al., 2006). The narrative review allowed for a deep and contextualized understanding of how the liberal arts contribute to the development of critical skills and essential competencies in scientific researchers, providing an integral and coherent view of the multiple aspects addressed in the study.

Source Selection

The inclusion criterion corresponds to relevant theoretical information that contributes to the presentation and explanation of the study. Consequently, bibliographic information from authors who systematically describe the liberal arts and scientific research was reviewed. The exclusion criterion is determined by documents do not present in indexed academic or scientific journals, a five-year time frame, and differences in the Spanish language.

Literature Review

Information collection is established through a search on major academic platforms and search engines like Google Scholar. Keywords were established to expedite the search for documents with information on the study variables. A content review was then generated to determine if they represented relevance to the study process. The synthetic-analytical method is used to identify necessary content for the research. This method "is very useful for the search and processing of empirical, theoretical, and methodological information. Information analysis allows breaking it down to find what is essential in relation to the study object" (Somano and León 2020, p. 4).

Additionally, the descriptive method is applied, which focuses on "seeking initial knowledge of reality produced from the direct observation of the researcher and the knowledge obtained through reading or studying information provided by other authors" (Abreu, 2014, p.198). In this context, this method describes the current state of the study phenomenon by understanding the factors and elements characterizing it.

Information Analysis

The tool proposed is hermeneutics, which allows for the interpretation of texts consulted in the research process. Pérez et al. (2019) indicate that "hermeneutics has methodological orientations at its base that analyze the world and its epistemic place in research processes" (p.23). In this case, hermeneutics is used to analyze information related to the liberal arts and scientific researchers.

Information Synthesis

The technique used in this research is critical document analysis, allowing for evaluating the logical form of how an author develops ideas and analyzing possible errors. In this sense, critical analysis: "Is a process of evaluation that allows the reader to form an idea of the potential error in study results, whether due to bias or confusion. Critical analysis largely verifies whether the study meets certain desirable methodological criteria or conditions." (Araujo, 2012, p.1).

Critical analysis does not provide a definitive result regarding the study's results' accuracy; however, it represents an approximation of the reliability of the resulting information, supported by bibliographic analysis and content. Therefore, if the documentation and information analysis is reasonable and coherent, it proceeds to the interpretation, discussion, and synthesis of the results. Furthermore, the inductive method is proposed. According to Abreu (2014), this method "observes, studies, and knows the generic or common characteristics reflected in a set of realities to develop a proposal or general scientific law" (p.200). This method studies the research problem specifically to establish general conclusions about the relationship between liberal arts and scientific research.

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RESULTS

In this results section, based on a narrative review, multiple topics are addressed regarding the influence of the liberal arts on the formation of scientific researchers and the dissemination of scientific knowledge. The historical and conceptual evolution of the liberal arts is analyzed, along with their contributions to the development of critical skills such as logical thinking, effective communication, and creativity. Additionally, the essential characteristics that define a scientific researcher are described, and how these relate to the competencies developed through the liberal arts.

Liberal Arts: The liberal arts emerged in the Middle Ages, influenced by classical antiquity. Their purpose is to liberate the human being through education, comprising a set of study areas, including natural sciences, art, humanities, and social sciences.

Collectively, the liberal arts constitute the ideal education serving students in the pursuit of science at its highest level. Education was divided into two categories: one composed of arts related to words and language study, and with whose knowledge it is possible to access the other category, such as arts of mathematical concepts. (Porras and Arranz, 2014, p. 377)

The subjects comprising the liberal arts are intended to provide individuals with the necessary tools to strengthen critical thinking, develop skills and aptitudes. As mentioned earlier, the purpose of teaching this is to liberate the human being from ignorance, which prevents them from achieving a state of well-being.

In the Middle Ages, the liberal arts were represented as female figures, something common at the time. Later, they were divided into two groups: the Trivium, including grammar, dialectic, and rhetoric, and the Quadrivium, including arithmetic, geometry, astrology, and music. According to Gonzales (2008), "The trivium focused on man and language, while the quadrivium aimed at understanding the cosmos from numbers, the par excellence instrument of measurement" (p. 36). Consequently, the union of these seven arts formed the highest universal expression of knowledge, considered the greatest effort of human understanding.

According to Martianus Capella: To better understand the liberal arts, it is necessary to discuss the work of Martianus Capella, a Roman writer from Africa, who flourished in the 5th century. *Nvptiis Philologiae Et Mercvrii* is a work written in the second half of the 5th century AD, in the context of the conflictive Late Antiquity (Cardigni 2019). The work narrates the marriage between Mercury and Philology, representing each of the liberal arts as maidens with unique personalities distinguishing them from each other.

The work consists of two main sections, intrinsically related to each other: the first two books, narrating how the god Mercury seeks a wife and how the chosen one, Philology, must strip off her mortal traits to ascend to the heavens and marry a god; and the remaining seven books, each dedicated to one of the Liberal Arts, which in the work are allegorical and respectable bridesmaids, a gift from the groom to his bride. (Cardigni, 2019, p. 27).

One prominent characteristic of *Nvptiis Philologiae Et Mercvrii* is its style, written in prose, like that of novels, called Menippean satire. Its peculiarity lies in writing a critique of mental aptitudes, sidelining specific individuals. Valdez (2016) indicates that "It is the realization of satirical criticism through fantasy […] (pagan or Christian eschatology, dialogues with or of the dead)" (pp. 223-224), also highlighting its fantastic nature, an epic narrative. In this sense, it discusses the seven liberal arts as entities approaching the divine.

The Trivium: Comprises three elements: knowledge, understanding, and teaching. From a perspective centered on areas of knowledge, this represents grammar, dialectic, and rhetoric. Each element is consequent of the previous one, representing the adequate path for knowledge development, understanding its creation, comprehension, and dissemination, generating a cyclical process that repeats to complete the same process. From a medieval perspective present in the book *Nvptiis Philologiae Et Mercvrii*, it is established that:

"Mercury, fulfilling his duty as a husband, presented to Philology the main dowry of his divine wedding gift: seven wise maids who would help his beloved in her constant advancement toward knowledge. Three of them (Grammar, Rhetoric, and Dialectic) would take care of perfecting her inner world." (De la Iglesia, 2021, p. 131).

Philology: Refers to "the science that studies cultures as manifested in their language and literature, mainly through written texts" (Real Academia Española, 2014, definition 1). In this scenario, the three paths of knowledge are personified as servants to Philology for perfecting their internal processes related to the freedom of the person's spirit. The three paths represent the foundations of the man's evolutionary process; as man learns and develops skills in each path, he gets closer to the path of freedom and knowledge, forming his behaviors in the quest for truth.

Grammar: The first path in the Trivium represents the proper use of language, writing, and reading. It represents an essential component in knowledge development, encompassing the basics of all knowledge. Through it, information is constructed and recorded. Grammar refines language skills, representing the correct use of words and their understanding. According to De la Iglesia (2021), its origins are depicted as follows:

"In the beginning was the word, which places Grammar at the start of all knowledge, so Zeus, aware of this immutable precept, advanced the first maid presented by Mercury. She was undoubtedly an elderly woman but of great charm, who said she was born in Memphis when Osiris was still king, where, after remaining hidden and ignored for a long time, she was found by Mercury himself and brought to Greece." (p. 131).

As an art dedicated to improving language skills, its representations express the care of the mouth, ensuring it remains free of impurities that may impair its functioning. In this context, it is described that:

"Her three basic functions: dental cleaning of those who pronounced vowels defectively, treatment of tongue diseases, and eradication of dirt generated in the city of Soloe", all of which prevent correct vocalization, appropriate syllabic differentiation, and the maintenance of the necessary correspondence between the name and the nominated thing. (De la Iglesia, 2021, p. 133).

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Proper grammar use elevates writing and reading style, enabling individuals to use figurative, stylized, and structurally rich language, capable of achieving the intended description of the idea, marking a significant difference when communicating with others.

Rhetoric: Considered the purest and most accomplished manifestation of language, rhetoric is complemented by grammar and dialectic, forming a cohesive path allowing individuals to properly articulate and execute words. Its use is directly related to literature due to the level of manifestation understood in its process. It is determined that rhetoric consists of the following elements: "the correct knowledge of the language, whose rules are established by Grammar's wisdom, and the fluency and beauty of the exposition, both of which come not from natural abilities but from daily practice and effort" (De la Iglesia, 2021, p. 138).

As the highest expression of language, rhetoric is interpreted as an elegant and prestigious element, capable of attracting the attention of anyone in its presence. Thus, "In Margarita Philosophica, Rhetoric is represented as an elegant and sumptuously dressed young matron, as her initial intention is to please those who come to hear her argumentation" (De la Iglesia, 2021, p. 139).

Dialectic: According to De la Iglesia (2021), dialectic responds to all learning disciplines, based on six elements: "The first concerns terms, the second pronunciation, the third proposition, the fourth syllogisms, the fifth critical reasoning, and the sixth refers to the proper style of orators" (p. 142). It guides logical thinking, argument analysis, and information synthesis, producing a final argument based on reliable knowledge. It is the work of thought that guides the dilution of objective information based on evaluations and perspectives of contradiction and affirmation.

The Quadrivium: As its name suggests, corresponds to four elements or paths of knowledge. It represents the knowledge of numbers or the world's external knowledge. It is recognized as the art of understanding the surroundings that encompass a person. The presented paths are considered studies of the art of numbers, leading to the development of thinking, knowledge, teaching, and learning. Its medieval origin establishes that:

"Mercury, fulfilling his duty as a husband, presented to Philology the main dowry of his divine wedding gift: seven wise maids who would help his beloved in her constant advancement toward knowledge […] the other four (Arithmetic, Music, Geometry, and Astronomy) would provide her with a broader understanding of the external world." (De la Iglesia, 2021, p. 131).

While the trivium was characterized by internal knowledge and the development of inner skills, the quadrivium focuses on spatial aspects surrounding a person, those arts waiting to be studied and understood by humans, allowing for a broader understanding of their environment. These paths of the liberal arts respond to stillness and movement, contemplating an unavoidable duality of the exterior. "The Quadrivium is dedicated to quantity, which can be permanent and motionless (Arithmetic and Geometry) or permanently in motion (Music and Astronomy)" (De la Iglesia, 2021, p. 148).

Arithmetic: Represents the first path of the Quadrivium, focusing on the study of numbers, quantitative, and countable elements. It delimits basic mathematical operations, focusing on developing logical thinking, problem-solving, and systematic analysis, considered one of the fundamental fields of various sciences. From a medieval perspective, it is determined that:

"Philology's third thought was dedicated to numerical analysis, intending to discover the harmonic relationship that would link her with Mercury. She counted the number of letters in her future husband's name with her fingers; and did the same with her own." (De la Iglesia, 2021, p. 129).

In this context, it is established that numbers are inherent to life; consequently, operations and manipulations of quantities are essential in the development of human knowledge. From a medieval perspective, numbers were considered sacred due to various configurations and subjective representations of what they might represent. Thus, it is established as follows:

"Recognize the sacred properties of the number one above all things and as the origin of even your divinity, which is why it is revered with the appellation of beginning. The unit is part of the whole and, at the same time, only needs itself to exist." (De la Iglesia, 2021, p. 147).

The art of arithmetic is represented in the foundations of the liberal arts as a young woman with two books, one in each hand, presenting the most important written representations of numerical operations, corresponding to "Pythagoras and Boethius, competing, one with the abacus and the other with Arabic numeration, to determine which system is the fastest in performing mathematical calculations" (De la Iglesia, 2021, p. 148).

Music: Represents the second path of knowledge in the quadrivium, determined as the study of numbers through movement and their passage over time. Music is the art of interpreting the harmony of sound structure. It is deeply rooted in mathematical knowledge because it involves the logical and orderly understanding of symbols and elements that together form a general, objective, and coherent result. Historically, music is conceived as Arithmetic's twin sister:

"From the moment I was conceived as Arithmetic's twin sister, I have never abandoned my relationship with numbers. I have followed and studied the orbits of the stellar spheres, assigning their swift movements the corresponding tones, allowing them to interpret the symphony of the stars known perfectly to all present here." (De la Iglesia, 2021, p. 152).

Thus, music represents the art of combining elements forming complex and complete structures that result in the harmony of sound. This entire process, using the knowledge of composition elements, is established as a complete learning element.

Geometry: This path studies and interprets numeration in space. It corresponds to the study of figures, lines, solids, and positions. It encompasses a natural thought of humans in the quest for knowledge through experimentation, measurement, and calculation of their surroundings. De la Iglesia (2021) states that:

"The toga covering the head of Tibaldi's Geometry is like Arithmetic's, as both come from warmer lands than Greece. They grew in pre-Pharaoh Egypt, though their birth possibly took place in ancient Mesopotamia bathed by the Euphrates and Tigris." (p. 157).

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Its focus is on studying the surroundings of humans, the things around them, and understanding these. Geometry develops through human curiosity and doubt in trying to discover the characteristics and compositions of elements forming their surroundings.

Astronomy: The last path of the quadrivium is characterized by studying numbers in space and time. It encompasses the knowledge of location, navigation, and movement, as well as the times directly related to these. Its interest lies in understanding the disposition of external bodies, the rotation frequency, and positions. De la Iglesia (2021) manifests:

"It is represented with different iconographies in Margarita Philosophica, depending on the various editions of Reisch's work during the 16th century. In the most known representation, Ptolemy, accompanied and advised by a young woman named Astrology, tries to measure the Moon's dimensions with a quadrant. At their feet, in the center of the iconography, stands a large astrolabe used to observe the position and movement of the stars." (p. 161).

Understanding the movement of space and the time it generates is proposed through numeration and calculations. It is understood that numbers are inherent to movement and time, allowing for precise results on how, when, and how long it will take for a specific action to occur within the cosmos field.

Scientific Researchers: They are responsible for developing the search for knowledge that will answer great uncertainties of human thought. They are characterized by possessing both essential attitudes and scientific knowledge. According to Linares and Nápoles (2013), "The researcher is a specialist, a professional qualified by their accumulated knowledge to respond to certain unknowns occurring in their surroundings" (p. 211). Additionally, they focus on specific areas of knowledge, thus broadening understanding of these topics.

Their relationship with science and the scientific method is fundamental to achieving research objectives. On the one hand, science is the set of knowledge that has been proven through observation and experimentation, leading to significant advances for humanity. Benítez (2020) expresses that "Science is the knowledge of the universal, which is demonstrable and valid for everyone" (p. 231). On the other hand, to achieve pure knowledge, appropriate methodologies are employed according to each research topic, called the scientific method, accepted verification systems by the scientific community.

"It is an orderly process that allows generating scientific knowledge of reality and verifying it, starting with identifying a problem, continuing with the review of existing literature on the identified problem. Based on this knowledge, hypotheses are proposed, then necessary information is collected for their verification or not, finally leading to conclusions constituting provisional scientific knowledge." (Yuni and Urbano, 2020, p. 171).

The great reference and creator of the scientific method was Aristotle, who began with particular observations until reaching general principles through observation. Burgos et al. (2020) explain that "Aristotle privileges the analysis of deductive reasoning, especially categorical deductive reasoning or syllogism. He considers that scientific knowledge is achieved by deducing the particular from the general, that is, through knowledge of causes" (p. 281). Thus, a method, a means used to achieve an end, is established. For this purpose, Aristotle followed the steps of observation, experimentation, hypothesis, and theory. Additionally, he established that all information used to formulate knowledge is perceived through the senses. Burgos (2020) states that "For Aristotle, the starting point of any form of knowledge is the senses. This means that any mode of information enters through the eyes, ears, smell, etc." (p. 285). In other words, knowledge creation is a specific quality of humans, starting with the perception of the surrounding reality through the senses.

Qualities of the Scientific Researcher: The qualities and attitudes of scientific researchers are skills allowing them to investigate, analyze, and systematize data to meet their research objectives.

Table 1: Essential Attitudes of a Scientific Researcher

ESSENTIAL ATTITUDES	Description
Honesty	The researcher must have integrity when processing data and handling results.
Curiosity	The researcher should investigate unknown aspects and ask why things are the way they are.
Discipline and Commitment	The researcher must be consistent to achieve the research objectives.
Order	The researcher should act according to the research being conducted.
Teamwork	The researcher must ensure a pleasant work environment.

Note: Delgado et al. (2020). Essential Competencies of the 21st-Century Scientific Researcher. Adapted by the Author.

Table 2: Essential Knowledge of a Scientific Researcher

ESSENTIAL KNOWLEDGE	Description
Philosophical Knowledge	Seeks to understand the nature of things through reasoned justification.
Epistemological Knowledge	Allows understanding the diversity of elements, applying rigorous steps to achieve knowledge.
Language Knowledge	It is essential for researchers to master English, enabling knowledge sharing worldwide.
Active Transformative Knowledge	Knowledge transcending experience, leading to a rigorous, systematic, and comprehensible process to reach truth.

Note: Delgado et al. (2020). Essential Competencies of the 21st-Century Scientific Researcher. Adapted by the Author.

Table 3: Essential Skills of a Scientific Researcher

ESSENTIAL SKILLS	Description
Interpersonal Relationships	Necessary skill for forming excellent teams, not only for work but also for friendship.
Practice of Values	Necessary to respect intellectual property, adhere to scientific community norms, and maintain integrity in all research stages.
Order	Skill enabling the researcher to be disciplined in the research process.

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Note: Delgado et al. (2020). Essential Competencies of the 21st-Century Scientific Researcher. Adapted by the Author.

The liberal arts represent the foundation for developing scientific articles, publications, productions, and research. Despite being considered arts, the disciplines within the Trivium and Quadrivium are inherently disciplines of knowledge. The literary and logical-mathematical focus of the arts forms the basic conceptions for developing more complex studies established in scientific productions.

The liberal arts and scientific production maintain a direct connection in the search, development, and dissemination of knowledge. These two concepts share a common goal centered on knowledge development in individuals and the dissemination of this information to society. While the former focuses on developing knowledge in humans, the latter focuses on disseminating research for humans.

By addressing various disciplines that can approach a research problem from a logical and social perspective, maintaining a contrast from literature and mathematics. Benítez (2020) expresses that "Science is the knowledge of the universal, which is demonstrable and valid for everyone" (p. 231). The research and academic development approach comprehends the functioning of both scenarios, as researchers must be capable of generating knowledge and conveying it adequately, using a language specific to academia to communicate their ideas and study findings.

Indirect connections are established; both seek knowledge, and, in some way, academics return to the foundations presented in the liberal arts. From these, desires to learn, analyze, and study the environment originate. While not established in a purely academic space like various research topics, it focuses on generating information for humans. While one seeks human liberation through learning, the other uses the same learning processes to elevate individuals to social and academic levels.

The paths of the liberal arts represent a structured process of knowledge formation, establishing particularities that focus on logical, critical, and systematic information development. These processes correspond directly to the programmed actions for creating scientific content. Nápoles (2013) states, "The researcher is a specialist, a professional qualified by their accumulated knowledge to respond to certain unknowns occurring in their surroundings" (p. 211). Thus, the liberal arts are directly related to developing scientific content. The liberal arts are sciences and encompass disciplines related to language and mathematics, fundamental to any science, established in statistical data analysis and the correct presentation of results through proper language use.

Considering the liberal arts outside the academic context would be to deny knowledge itself. These variables must be understood as knowledge formers. In another sense, the arts are science, establishing knowledge dedicated to individual liberation, which, beyond developing scientific capacity, focuses on establishing academic growth in individual formation, developing a process of internalization, understanding, and development of research foundations. Understanding "an orderly process that allows generating scientific knowledge of reality and verifying it, (…) finally leading to conclusions constituting provisional scientific knowledge. (Yuni and Urbano, 2020, p. 171).

The liberal arts can form better scientific researchers because they encompass a process aimed at forming and growing individuals through knowledge, a process inherent to scientific research development and production. The lack of research in this field or related to training is due to the lack of establishment with the liberal focus.

The liberal arts foster critical thinking development by exposing individuals to different perspectives, criteria, thought currents, and forms of expression. In this sense, critical thinking represents a fundamental skill for scientific researchers, allowing them to question study objects and phenomena, analyze information objectively, and reach well-founded conclusions.

Likewise, by establishing disciplines focused on the free development of humans, they represent a degree of creativity, inspiring individuals to explore new ideas, experiment with different knowledge areas, and develop their criteria. In scientific production, creativity is essential, driving researchers to think innovatively, propose original solutions, and address problems from different angles, thus encompassing the research problem's solution with objective and original criteria. Thus, "Science currently must be understood as an inclusive space in which art—through artistic research—provides new forms of information to understand the world" (Zambrano, 2016, p.116).

The findings indicate that, although the liberal arts and scientific research may seem like distinct disciplines, they can effectively complement each other in the pursuit of knowledge and human development.

CONCLUSIONS

It is determined that the liberal arts represent disciplines aimed at developing critical thinking, logic, and individuals' analytical capacity. These include areas such as literature, rhetoric, mathematics, among others. While they may seem distant disciplines from the scientific environment, the liberal arts play a necessary role in forming researchers. One of the main contributions to scientific research is developing critical and logical thinking. Researchers trained in disciplines like literature or philosophy can critically analyze and evaluate research information.

Likewise, another faculty presented through the liberal arts is effective communication. Researchers must be able to coherently communicate their ideas and results, both in writing scientific articles and in different forms of information dissemination. The disciplines presented in the trivium, such as literature and writing, teach researchers to express themselves persuasively and adapt their communication style to academic audiences, where adequate result dissemination is crucial for advancing knowledge.

These disciplines provide researchers with a deep understanding of the society and culture framing their research, allowing them to contextualize their studies, identify trends, and understand the influence of social and cultural factors on scientific processes. This interdisciplinary perspective is indispensable in current

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scientific research, increasingly facing complex problems requiring a holistic approach.

The influence of the liberal arts on scientific research is evident in the production and development of knowledge, in the way researchers approach their studies, formulate research questions, and present their study results. Considering the influence of the liberal arts on scientific research, it is necessary for educational institutions to integrate these disciplines into researchers' training. Thus, higher education should foster interdisciplinarity and promote collaboration between different knowledge areas to encourage innovation in scientific research.

It is considered that the liberal arts and scientific research, despite appearing discordant systems, are two disciplines that adequately complement each other in the search for and development of knowledge and human advancement. The liberal arts positively influence the formation of academic researchers and the advancement of scientific research. It is established that the disciplines present in this focus not only provide the fundamental research skills such as critical thinking and effective communication but also foster a deep understanding of the study areas framing the research. Consequently, integrating the liberal arts into scientific training is essential to fostering creativity, innovation, and progress in the research field.

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