# Construction of a literature map on collaborative virtual white boards

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## Abstract

The aim of higher education is to make the student the protagonist of their learning. In this context, the researchers must create appropriate scenarios that enable students to explore and develop critical thinking both independently and cooperatively while making use of information technology. This paper presents a model of pedagogical practice in the subject of Introduction to Research Methodology (IRM) based on the construction of literature maps applying John W. Creswell's research design theory through the use of virtual whiteboards. 120 students from the seventh cycle of the study plan of the School of Architecture of the National University of San Agustín participated. As a result, the model used in this paper enabled students to collect and organize the data necessary to formulate their research and develop critical thinking based on scientific knowledge. In this process, it was possible to reflect on the importance of emphasizing the development of critical and creative thinking skills in order to create literary maps that contribute to the comprehensive education of students. It should be noted that students are obliged to be protagonists in the construction of their knowledge especially in subjects that develop competencies related to scientific research.

## Contents

**Contribution of this paper to the literature**
This paper represented the importance of critical and creative thinking skills in the development of literature maps. Students are currently expected to take the lead in building their knowledge which requires the acquisition of   skills for scientific research.

## 1. Introduction and Objectives

The COVID-19 pandemic-related restrictions on movement and social contact faced in the previous two years have expedited the growth of conventional teaching practices at all educational levels compelling us to reconsider the resources and approaches required for effective learning. In this context, Information and Communication Technologies (ICT) are beneficial   to the world's population because they support the development of the teaching and   learning process. Their application represents a challenge for university professors  who must adapt to them while maintaining the benefits of face-to-face teaching  such as the application of active methodologies (Labrador, Andreu, & De Vera, 2008). These methods have the benefit of emphasizing the process of creating activities rather than the contents and allowing students to actively participate, cooperate and develop their creativity.   The educational system must be student-centered in order to make students participate in a meaningful scenario (Bugg & Dewey, 1934; Manchego & Butrón, 2020) that allows them to experiment, reflect and develop the critical and creative thinking skills necessary for research.

Many works in different areas of university education have been developed around the difficulties experienced by students in learning research skills (Guerrero, 2007; Lanuez & Pérez, 2005; Ruíz & Torres, 2005). A well-developed field focuses on showing how the development of research skills influences professional development (Carrillo-Larco & Carnero, 2013; Chirino, 2002; Guerrero, 2007; Machado, Montes, & Mena, 2008) but recently there has been interest in observing research training from the perspective of the  development of skills (Moreno, 2005). This last line of research is particularly important because it is based on constructivism, with a   focus on learning and giving meaning to research training which is one of the processes that allows higher education to respond to the sociocultural problems of nations through the creative participation of subjects in solving the problems of their reality.

Two identical goals were presented in this study.  First, to develop a teaching program for the Introduction to Research Methodology (IRM) course based on John W. Creswell's Research Design Theory through the use of collaborative whiteboards and the development of critical and creative thinking skills and second to assist students in  the process of gathering data and developing research skills which will lead to the individual and group development   of the theoretical framework and methodological design. This will allow students to develop the skills necessary to support their theoretical framework and the design of their research methodology.

The findings demonstrate various methods used in designing the theoretical framework. The study provides evidence for the applicability of earlier instrument designs that direct and organise data collection and analysis within the theoretical framework and methodological design to compare student development.

## 2. Literature Review

Currently, there are different approaches to conduct a review of research. Some of the main approaches show a review as a theoretical construct or as research in its own right. In this sense, three trends were also identified for the purpose of conducting a review. These are: retrieving information and describing, understanding the topic and retrieving information to transcend reflexively (Gómez, Galeano, & Jaramillo, 2015). A literature review is a critical synthesis of ideas, problems, approaches and research results on a particular topic.  Furthermore, Fink (2019) defines a research literature review as a systematic, explicit and reproducible method to identify, evaluate and synthesize the existing body of work conducted and recorded by researchers.

 There are several benefits to conduct a successful literature review including the ability to organise the material and critically analyse it which necessitates challenging, criticizing and developing hypotheses to explain it Franco (2007); López (2009) and Zapata (2009). According to some authors, it is necessary to apply an interpretive character (Medina, 2004) which enables to create new knowledge (Baeza, 2008; Chica, 2009; Velásquez, 2009) based on the analysis of bibliographic material with a critical interpretative character (Carmona & Montoya, 2009).

In addition, literature reviews have many uses including guiding current professional practices and evidence-based practice, providing information for reports for personal curiosity and supporting requests for financial support and academic degrees.

According to Kiteley and Stogdon (2014), the main purposes of the literature review are to (i) establish what has already been researched, (ii) establish what methods have been used previously in the subject, (iii) establish what has worked in terms of the research process, (iv) identify and exploit knowledge gaps.

Hoyos (2000) stated that  the art and literature review is also a research with its own development that falls within the field of documentary research. However, he considers that its essential purpose is "to account for constructions of meaning on data that support a diagnosis and a prognosis in relation to the documentary material submitted to analysis". In other words, it seeks to go beyond the known parameters in order to generate a coherent order capable of explaining the meanings of a particular topic. On the other hand, Toro and Parra (2010) compare the state of the art with the background review, proposing it as an important methodological moment in any research process since it seeks to find out the current state of the research problem.

Therefore, it is important to unify criteria during the research process by making use of the literature review as a guide for the formulation of undergraduate projects and even major research. The researcher proposes to do something original, innovative   or useful in some way.

### 2.1. Systematization of Academic Literature Reviews: Literature Mapping

Creswell and Creswell (2018) propose seven steps to perform a literature review:  (i) identify the keywords that allow identifying a topic, (ii) perform a search in computerized scientific databases, (iii) recognize 20 scientific articles related to the research topic, (iv) select the most relevant articles   performing a superficial reading, (v)

design an initial literature map that allows organizing the information, (vi) perform the synthesis of the relevant articles including the references and finally (vii) gather the literature review in a structured way.

The proposed steps allow the development of critical and creative thinking skills (CCTS). The thinking skills involved in the development of the literature map correspond to 5 skills .First, comprehension enables identifying the objective and goal of the material and determining the context in which it was developed. It is essential to develop skills such as analysis (identifying the main ideas and the relationships between them), assessment (allowing us to recognize the logical strength of ideas), inference (all thought contains inferred ideas through which we give meaning to situations) and explanation (the expression of thoughts in a coherent and reflective way that allows us to contribute to inventiveness). All these skills significantly contribute to the development of scientific reasoning (Prado-Arenas, Junyent, & Oliveras, 2022). John W. Creswell's 7 steps of the literature review are presented in Figure 1.
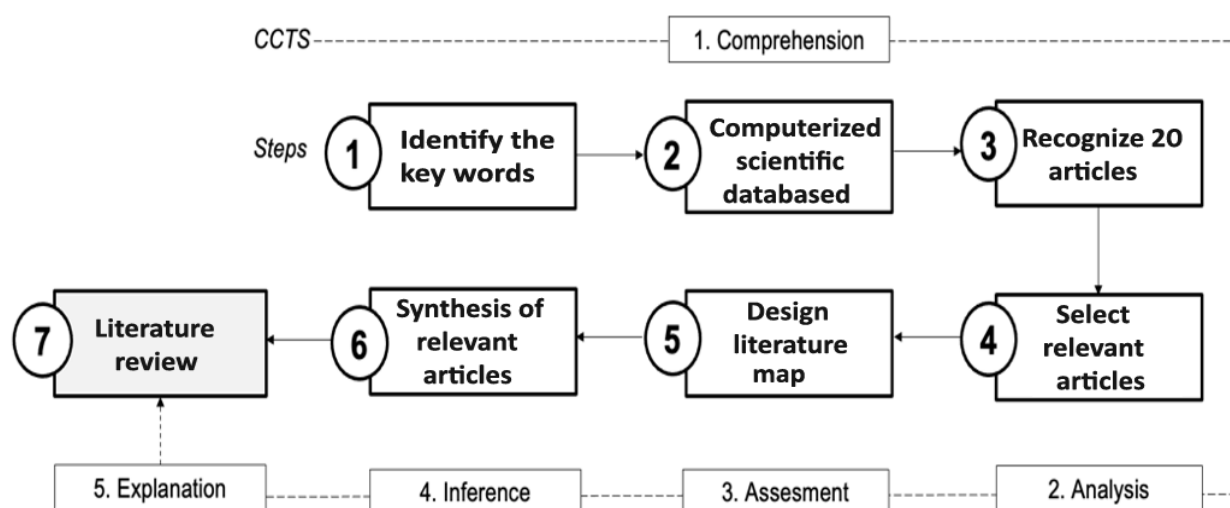


**Figure 1.** John W. Creswell's 7 steps of the literature review.

Bojacá (2004) also highlights the literature review's claims to be able to: define and characterise the field of study; identify and examine what is pertinent; contextualise the research and finally, obtain a balance of the information obtained, locate it and relate it to other data. Baeza (2008) points out the importance of systematizing and describing the knowledge produced by analyzing it critically. In other words, after the organization of information, it is essential to describe what was found, showing through a construction of meaning the data collected that will be evidenced in the literature map.

In step 5, the design of the literature map is supported by the design of a mind map. Mind maps allow to associate and express concepts, arguments and ideas. Students who are new to scientific research find this tool a way to communicate their progress in the literature review. The researcher should begin the visual construction of the existing literature on the topic, presenting an overview of it. The design of the literature map can take various forms, concept maps and flow charts depend on the intentions to be communicated, whether they are hierarchical or relational and thus express the arguments visually.

The overview of the literature map with respect to information management starts with the first four points of the process: identification, search, recognition and selection of information based on scientific articles that analyze the main components within a specific field of research. It also makes it possible to present the evolution of interest in the subject under study over time. Using these techniques, literature maps can be created, visualized and better explored.

## 2.2. Collaborative Whiteboards as a Tool for Scientific Learning

The development of information and communication technologies (ICT) is currently advancing at an accelerated pace and incorporating new forms of communication (Palomo, Ruiz, & Sánchez, 2006). It is not a matter of introducing new processes but of adapting to the use of technology through the different tools currently available that can promote new didactic possibilities during the teaching stage that foster a critical and creative spirit while mobilizing skills such as comprehension, analysis, inference and explanation with more active participation by students.

It is clear that today's university students have access to knowledge because of the internet. Therefore, the teaching-learning process should not be focused on providing information but on providing appropriate tools to process information so that students have critical thinking skills that allow them to understand, analyse and infer conclusions from the information available to them. In this sense, the importance of learning over teaching and the implementation of digital tools are highlighted (Bergman, 2014).

One of the digital tools that facilitate this change of vision is virtual whiteboards. Currently, there are various virtual whiteboard applications that facilitate the choice of users with respect to their needs. All of them have different characteristics highlighting the advantages they share such as (i) the contribution to the creation of content in a collaborative way, working virtually (Dominguez & Carmona, 2017), (ii) the promotion of student participation in the creation of knowledge and finally (iii) the contribution to the improvement of cognitive performance and the promotion of deep understanding of key concepts (Resta & Laferrière, 2007).

On the other hand, the use of new technologies appropriate for teaching leads to the assignment of new roles and tasks by students, given the need for a paradigm shift from traditional teaching models to new innovative learning models (Dominguez & Carmona, 2017). There are new strategies that may be used to promote active involvement among all students through a collaborative learning environment.

# 3. Method

## 3.1. Population and Sample

This pedagogical practice was developed in the Introduction to Research Methodology (IRM) which is part of the seventh cycle of the study plan of the Faculty of Architecture and Urbanism of the National University of San Agustin de Arequipa (FAU-NUSAA). In 2021, the IRM course consisted of 5 groups with an average of 30 students per group. Four groups were selected by convenience sampling because they were taught by two teachers. The sample is composed of 59 research projects corresponding to 22 projects developed in pairs and 35 projects developed individually.

## 3.2. Instrument

The proposed methodology is structured based on an instrument implemented from research design theory and on the literature map model described by Creswell and Creswell (2018). With the instrument, the 7 steps of Creswell's literature map model are implemented  which are structured around two criteria. In the first one, related to the Bibliography Annotated (BA), the first four steps are working  which consist of: (i) identification of keywords, (ii) search in index  databases, (iii) recognition of 20 articles, (iv) selection of relevant articles  where the critical and creative thinking skills (CCTS) developed by architecture students are considered: comprehension and analysis (see Table 1).

**Table 1.** Instrument for the design of the literature map (first stage)

| Creswell steps | 1. Identify | 2. Search 3. Recognize | 4. Select |
|---|---|---|---|
| Components | 4 key words | 20 general items | 3 Items |
| | | | 3 Items |
| | | | 3 Items |
| CCTS | Comprehension | Comprehension | Analysis |
| Method | Annotated bibliography | | |

The following steps are taken in relation to the requirements for using the collaborative virtual whiteboard (CVB):  (1) synthesize the relevant articles, (2) design the bibliographic map and (3) gather the literature review. The second-stage architecture students' critical and creative thinking skills (CCTS) development included: interpretation, inference and assessment (see Table 2).

**Table 2.** Instrument for the design of the literature map (second stage)

| Steps of Creswell | Synthesize | 6. Design | 7. Gather |
|---|---|---|---|
| Components | Subtitle 1.What was investigated? | Diagram 1 | |
| | Subtitle 2. Establish methods andmethodologies. 3. Evaluate what was effective during the research process. | Diagram 2 | |
| | Subtitle 3. Identify the knowledge gap. | Diagram 3 | Conceptualization |
| CCTS | Assessment. | Inference and explanation | |
| Method | Collaborative virtual whiteboard. | | |

The student gains specialized knowledge of  the research topic and acquires information to use in the development of their theoretical framework.

## 3.3. Data Collection and Analysis Procedure

Data collection and analysis were carried out based on two  criteria: the first related to the identification of the annotated bibliography (AB) and the second to the use of the collaborative virtualwhiteboard (PVC).

## 3.4. Annotated Bibliography (AB)

The procedure for data collection in the *annotated bibliography* (AB) is based on the following structure:

$$AB = \frac{Identify\ (PCB+AP) + Search\ (AU+TA+PCA) + Recognize(Re+Ra+Q) + Select\ (O+A1+A2+A3)}{NAE}$$

| | |
|---|---|
| *AB: Annotated bibliography* | *Ra: Magazine ranking* |
| *PCB Search keywords* | *Q: Quartile to which the journal belongs* |
| *AP: Year of publication* | *O: Objective of the article* |
| *AU: Author(s)* | *A1:Argument1 for your selection* |
| *NA: Article title* | *A2: Argument2 for your selection* |
| *PCA: Article keywords* | *A3: Argument3 for your selection* |
| *Re: Journal of publication* | *NAE: Number of specific articles* |

Table 3 presents information for the data analysis. In making a comparison table between the delivery of unit II of the course and unit III, the number of articles evaluated for each research and the total number of words that made up the state of the art were taken into consideration.  As a result, a database is generated with the structure shown in the following table:

**Table 3.** Excerpt from the database structure for the annotated bibliography

| Name of research project (PI) | UNIT II | | UNIT III | |
|---|---|---|---|---|
| | Number of articles in database | Number of words in the state of the art | Number of articles in database | Number of words in the state of the art |
| PI – 1 | 12 | 12 | 1410 | 1370 |
| PI – 2 | 13 | 13 | 1107 | 1143 |
| PI – 3 | 13 | 17 | 1176 | 1221 |
| PI – 4 | 12 | 15 | 425 | 1296 |
| PI – 5 | 13 | 13 | 1253 | 1314 |
| PI – 6 | 12 | 15 | 1524 | 1479 |
| PI – 7 | 11 | 22 | 970 | 1042 |
| PI – 8 | 10 | 8 | 1340 | 1147 |
| PI – 9 | 7 | 3 | 1274 | 1324 |
| PI – 10 | 12 | 12 | 1407 | 1410 |

### 3.5. Collaborative Virtual Whiteboard (PVC)

The procedure for data collection in the PVC has a comparative structure based on the feedback of contents from specific FAU-UNSA research. Therefore, it is based on the following structure:

$$PVC= \frac{E1 + E2+E3}{LIE}$$

PVC: Collaborative virtual whiteboard     E3: Outline for state of the art 3
E1: Outline for state of the art 1     LIE: Specific line of research
E2: Outline for the state of the art 2

The data collection procedure in this group has 57 research projects into the five specific lines of research (LIE) of the FAU- UNSA which are: L1: territory, architecture and urbanism, L2: social housing and urban space, L3: urban mobility and public space, L4: innovation in architectural design, L5: architectural heritage. In this way, students who have completed their research in each line can identify common themes among their peers. The collaborative virtual blackboard is structured according to the following table:

The data analysis was based on the number of schemes presented. It was noted that some students were only able to create the first or second scheme that was appropriate for their level of expertise due to the complexity of the schemes' designs. It should be noted that schemes 1 and 2 contain a number of key words that show a complete graphic summary of what was written in the state of the art and scheme 3 is the sum of schemes 1 and 2. This allows us to evaluate the data when elaborating outlines.

Table 4 shows the outlines of a research paper. The research work belongs to urban mobility and public space. Initially, the authors understand that universal accessibility and design based on the multidisciplinary function of public spaces were relevant topics for their research. As a first step, the authors configure the first fundamental scheme (E1) into three keywords: universal accessibility, urban barriers and non-autonomous people. When they continue to explore these keywords, they discover three more terms that help them comprehend the subject of universal accessibility. The following three keywords are configured in the second scheme (E2): public space, physical-social barriers and social construction. Finally, the authors of the research find that the multidisciplinary perspective studied from the perspective of urban accessibility and public space allows them to understand the subject and synthesize a third scheme (E3).

**Table 4.** Data analysis framework for the collaborative virtual whiteboard and examples.

| L1 urban mobility andpublic space | E1 | E2 | E3 | Content |
|---|---|---|---|---|
| "Universal accessibility and design based on the multidisciplinary function of public spaces." |  |  |  | 3. Diagrams |
| Descriptive words of theschemes | 1. Universal accessibility<br>2. Urban barriers<br>3. Non-autonomous mobility. | 4. Public space<br>5. Physical and social barriers<br>6. Social construction | 7. Multidisciplinary perspective of urban accessibility and public space. | 7 specific keywords |

## 4. Results

The results are structured according to the two criteria considered and evaluated.

Criteria 1. Annotated bibliography. Selection of Articles.

Criteria 1 referred to the annotated bibliography: It shows the information obtained in the development of units II and II of the course in which the number of articles reviewed by the students was used to build their literature map. This criterion gathers the results of the application of the first 4 steps of the Creswell Theory: (i)

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identification of key words, (ii) search in index databases, (iii) recognition of 20 articles, (iv) selection of relevant articles. In this process, the application of CCTS was observed (comprehension and analysis).

The results show that in unit II, the maximum number of articles reviewed is 18 and in unit III, the maximum number of articles reviewed is 22. 22% have reviewed between 11 and 12 articles in unit II   while in unit III, 39% have reviewed between 12 and 16 articles   as shown in Table 5.

**Table 5.** Number of articles reviewed in units II and III.

| Unit II | | | Unit III | | |
|---|---|---|---|---|---|
| **Intervals** | **Frequency** | **Percentage** | **Intervals** | **Frequency** | **Percentage** |
| [0,2.6] | 6 | 10.5 | [3,5.7] | 3 | 5.3 |
| [2.6,5.1] | 10 | 17.5 | [5.7,8.4] | 4 | 7 |
| [5.1,7.7] | 7 | 12.3 | [8.4,11.1] | 6 | 10.5 |
| [7.7,10.3] | 5 | 8.8 | [11.1,13.9] | 27 | 47.4 |
| [10.3,12.9] | 22 | 38.6 | [13.9,16.6] | 12 | 21.1 |
| [12.9,15.4] | 6 | 10.5 | [16.6,19.3] | 4 | 7.0 |
| [15.4,18] | 1 | 1.8 | [19.3,22] | 1 | 1.8 |
| Total | 57 | 100,0 | Total | 57 | 100.0 |

The data distribution is symmetrical in terms of the concentration of the number of articles reviewed per work unit in the course.   Figure 2 shows that in unit II, the concentration of items is normal since the kurtosis is meso-kurtic   and in unit III,   there is a high concentration with a leptokurtic kurtosis. Although the degrees of concentration are slightly varied, both are concentrated in the range of classes 4, 5 and 6.
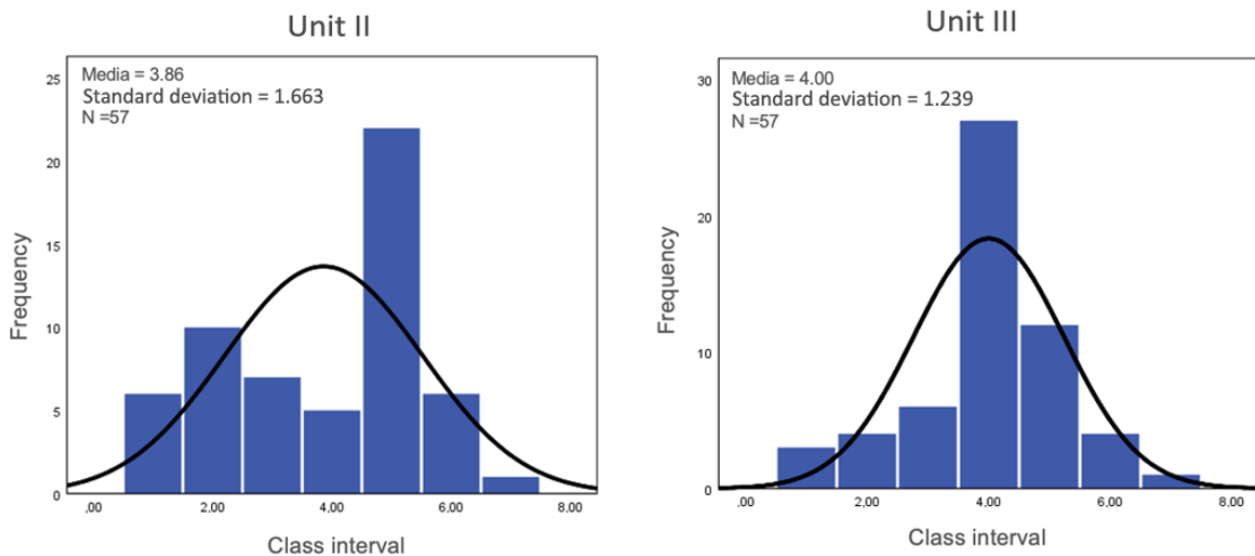


**Figure 2.** Histogram of the number of articles reviewed in unit II and III.

Criteria 2. Evaluation system of the scientific research base in collaborative virtual whiteboards.

For criterion 2, the use of collaborative virtual whiteboards (CVWs) was reviewed. This criterion considers the results obtained from the application of the last 3 steps of Creswell's Theory: (v) synthesizing relevant articles, (vi) designing the bibliographic map and (vii) gathering the bibliographic review. It is also considered that during the process the CCTS   developed by the students are assessment, inference and explanation.

The evaluation of this criterion is developed in a score ranging from 0 to 20 points   where the choice of key words, the presentation of the 3 schemes and the quality of the same, according to the line of research developed by the students   are taken into account. The results of the whole group are shown in Table 6   where it is observed that in Unit II, the maximum grade obtained is 17   with only 3.5% reaching grades between 16 and 17 points. Out of 57 participating students, 25 constitute the majority obtained between 11 and 12 points (see Table 6).

Regarding unit III, the maximum score achieved is 16   in which the majority of students are  22 corresponding to 38.6% of the students achieving a score between 15 and 16 points (see Table 6).

**Table 6.** Unit notes 2 and 3.

| Unit II | | | Unit III | | |
|---|---|---|---|---|---|
| **Intervals** | **Frequency** | **Percentage** | **Intervals** | **Frequency** | **Percentage** |
| [6,7.6] | 1 | 1.8 | [8,9.1] | 2 | 3.5 |
| [7.6,9.1] | 2 | 3.5 | [9.1,10.3] | 2 | 3.5 |
| [9.1,10.7] | 2 | 3.5 | [10.3,11.4] | 1 | 1.8 |
| [10.7,12.3] | 25 | 43.9 | [11.4,12.6] | 9 | 15.8 |
| [12.3,13.9] | 10 | 17.5 | [12.6,13.7] | 8 | 14.0 |
| [13.9,15.4] | 15 | 26.3 | [13.7,14.9] | 13 | 22.8 |
| [15.4,17] | 2 | 3.5 | [14.9,16] | 22 | 38.6 |
| Total | 57 | 100,0 | Total | 57 | 100.0 |

Figure 3 demonstrates how the representation of data related to each unit's grades is asymmetrical. In unit II, the distribution of grades is normal   and in unit III, there is an asymmetrical distribution to the left.
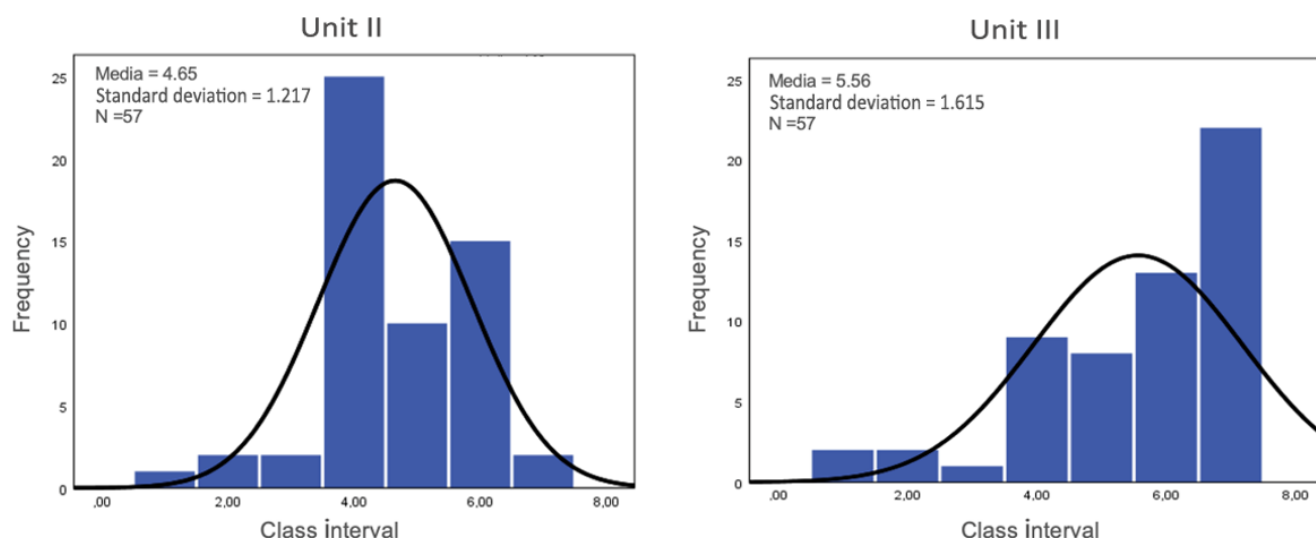
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**Figure 3.** Histogram of units II and III grade results.

## 5. Discussion

The beginnings of scientific research and learning about indexed journals, bibliographic databases and other sources of scientific information provide learners with a variety of challenges during their higher education. These sources represent a complex organisation of information and organisms that must be demonstrated in the most didactic and precise manner. Students organise content and develop knowledge using Creswell's seven phases of bibliographic review, realising that using theoretical bases is a continual and ongoing process. Therefore, the results of criterion 1 referred to in the annotated bibliography, corroborate this progressive process, since the selection of articles is increasing from unit II to unit III. However, the results show in unit III that the student concentrates his selection of articles in a selective process based on quality rather than quantity. The latter implies that the students understand the process and establishes the need for information gathering and analysis of the articles in search of the main ideas that will help them support and relate to the chosen research topic.

According to the second criterion analysis, the maximum scores achieved by the students show a positive performance in the activities. In unit II, they reached a maximum score of 17 points out of 20, although they obtained only 3.5% and most of the students focused on scores that passed the minimum pass mark (11 and 12 points). This indicates that the majority of students reach the minimum passing score with a positive minimum performance.

According to the findings of unit III, 38.6% of students achieved the maximum score. We can assume that the applied methodology provides an adequate path and the necessary tools to achieve effective improvements in the construction of the literature map.

Observing the data obtained, it is important to reflect on the need to establish clear guidelines for the methodology of application and evaluation of the elaboration of literature maps related to the notes of each unit to corroborate the continuous improvement of the student regarding the teaching-learning process during the application process established from Creswell's Theory, the collaborative virtual blackboards and the development of critical and creative thinking skills in the process.

The traditional teaching-learning process in research methodology generalises students. Therefore, it neglects the individual abilities and skills of the students. The development of critical and creative thinking skills (CCTS) is not valued in the process. Therefore, an important contribution of the designed instrument is its ability to identify the annotated bibliography (BA) and the configuration of the collaborative virtual whiteboard (PVC) to consider the creative process in the construction of the state of the art.

## 6. Conclusion

Creswell's theory explains the research design process. However, teaching in the virtual modality requires strategies for adaptation and management of ICT-mediated learning which constitute an important opportunity to improve teaching-learning processes. These tools allow students to organize and construct their knowledge in virtual environments both individually and collaboratively with their classmates and teachers. Thus, they acquire indispensable skills for the support of the theoretical framework and the design of the methodology of their research. The integration and combination of different resources is important for comprehensive education.

Although this work focuses on the application of Creswell's theory through collaborative virtual whiteboards, it was possible to reflect on the importance and need to emphasize the development of critical and creative thinking skills necessary for its successful development in the short- and long- term. These skills are necessary for the research process and they can contribute to comprehensive training in the long term.

The students' training process requires instruments that guide and structure the collection and analysis of information. In a virtual teaching context, one of the main challenges is participation and commitment in collaborative work, so the teacher must seek new ways to promote these workspaces. In this sense, virtual whiteboards have allowed the teaching-learning process to link students' activities in real time to strengthen the instrument proposed by teachers.

Nowadays, students are required to be protagonists in their knowledge and develop research skills, so the teacher acquires the role of companion or guide.

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