Developing research capacities for undergraduate students using instructional strategies in virtual learning environments

Desarrollo de capacidades de investigación para estudiantes universitarios mediante el uso de estrategias instruccionales en entornos virtuales de aprendizaje

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Keywords
Research capacities; instructional strategies; virtual learning environment; research

ABSTRACT

This paper contributes to the development of research skills in university students, through the use of instructional strategies in virtual learning environments, in order to achieve that students obtain the necessary skills and abilities to improve their research processes. To determine which are the research capacities to be developed, a literature review is carried out, whose objective is to identify the studies that are suitable with the teaching strategies. An analysis of the instructional strategies that can be carried out with the research capabilities of undergraduate students is also performed. The virtual classroom designed to be applied to students in teaching research skills is described. To validate the proposed competencies, the students were evaluated to determine the level of development of the research competencies through a questionnaire that measures their knowledge and a global improvement in the application of the investigative competences of 13.5% is obtained, demonstrating the validity of the use of instructional strategies through a virtual environment.

Palabras clave
Capacidades de investigación; estrategias instruccionales; entornos virtuales de aprendizaje; investigación

RESUMEN

Este artículo contribuye al desarrollo de capacidades de investigación en los estudiantes universitarios mediante el uso estrategias instruccionales en entornos virtuales de aprendizaje; esto, con la finalidad de que los estudiantes obtengan las habilidades y destrezas necesarias, y que puedan mejorar sus procesos de investigación. Para determinar cuáles son las capacidades de investigación a desarrollar, se realiza una revisión de literatura con el objetivo de identificar los estudios afines al objeto abordado. También se examinan las estrategias instruccionales vinculadas a las capacidades de investigación de los estudiantes de pregrado analizadas. Se describe el aula virtual diseñada y aplicada a los estudiantes para que adquieran las capacidades propuestas, para validar estas, se hace una evaluación a los estudiantes a fin de establecer el nivel de desarrollo adquirido en cuanto a las capacidades mencionadas, a través de un cuestionario que mide sus conocimientos, el cual arrojó una mejora global en la aplicación de las competencias investigativas del 13.5%, lo que demuestra la validez del uso de las estrategias instruccionales en un entorno virtual.

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INTRODUCTION

Nowadays, higher education is centered in training college students to acquire skills and abilities with the purpose of fostering a comprehensive education. In order to learn research skills, designing a supplementary instruction plan is the element of choice by means of innovative and alternative teaching strategies that would enable the development of such skills. This implies that a research culture is to be strengthened at school aimed to generate the skills and produce and use new knowledge. This is a basic element in the educational process which generates new knowledge (Gonzalez, 2004). Therefore, colleges ought to nurture the acquisition of research skills on students and to incorporate them as a teaching-learning strategy in the curriculum (Miyahira Arakaki, 2019).

In the field of higher education, research competencies are skills teachers ought to acquire so that they would understand the research process and therefore perform their role, thus conveying knowledge (Lau *et al*., 2015); although undergraduate students barely acquire basic research skills and abilities which they learn as a practical experience, but are not included in their curriculum or in their degree. On the contrary, if bases were established for an instructor to carry out the research, then, on his own, the instructor would contribute so that students would develop their investigative spirit and therefore be skilled to cause teaching experiences by means of discovery and construction of knowledge, centered in each student's potential (Garcia Gutierrez and Aznar Diaz, 2018).

Development of research skills is defined as an individual development process as a way to reach the highest skills for the performance of useful research (Moore, Crozier & Kite, 2012; Trotslte, 1992). Generally, universities require students to take courses so that they acquire research skills at a post-degree level, but getting these skills in the pre-degree academic area is not the responsibility of the instruction program. The main problem associated to pre-degree students is to match the student's knowledge level to his/her research capacity.

This problem may be minimized by applying specialized teaching practices in the specific research areas required by the student (Beckerleg & Collins, 2007); however, there are shortcomings demanding the need to look for signs that would help design, structure and share a set of didactic strategies in the most efficient

manner that would aid in self-instruction to do research. These strategies would help pre-degree students to focus on relevant purposes, such as searching, identifying and implementing research skills that would provide new knowledge (Reyes, 2013).

Instruction and development of research skills are trendy in scientific literature. Among the works in this area, we may quote those of Barth *et al.* (2007); Beckerleg & Collins (2007); Davidson & Palermo (2015); Emelyanov, Teplyakova & Boltunova (2017); Hughes (2019); and Ismuratova *et al.* (2018), which propose research competencies, skills and capabilities oriented to a post-degree, specialization or doctorate level. In spite that these studies have contributed to an analysis to determine the best precedents in the area of research capacities, they are not sufficient because they are not oriented towards a pedagogic or systematic approach supported by specific instructional techniques or strategies. In these studies, it is neither mentioned that research skills are supported by their use in virtual learning environments (VLEs).

The purpose of this work is to develop research skills on college students by using instructional techniques supported by VLEs for the improvement of research processes. In this sense, we have evaluated the research capacities of 54 students and applied proper teaching techniques with virtual learning material; thus, we have established the improvement of proposed capabilities.

The document is organized as follows: in the first section, we have presented related works, proposed the problem and justified the object of the research; in the second section, we have described the procedure to determine the research capacities considered in the survey; later on, we specified the methodology we used to establish instructional strategies in accordance with the proposed survey, aimed to create the virtual environment and to evaluate research capacities; finally, we have performed an analysis of the results of the evaluation of proposed capabilities, and detailed the conclusions of the survey.

DETERMINATION OF RESEARCH CAPACITIES

At present, there is an urgent need of universities to develop research capacities of students aimed to improve the quality of education. In spite that these capabilities are qualified as a traverse element in higher education at educational institutions, it is

convenient that they are considered as the result of generic learning for the graduate (Coates, 2014), in such a way that they gain the specific level of these capabilities by means of teaching strategies and promote the construction of knowledge.

In order to determine what research capacities are to be implemented in a training course for college students, we reviewed the literature whose objective was to identify research capability studies that were related with teaching strategies. We performed an advanced search in Scopus and in Google Scholar, and restricted the range from 2005 to 2019. The terms of the search included were as follows: *research capacities, education, instructional strategies, e-learning, higher education* and *virtual course*. We have also considered some synonyms of the search in English. From these results, we selected studies that foster some kind of research capacities. In the following paragraphs, we synthesized the works that helped us to determine the proposed capacities in this research.

The survey of Emelyanova *et al.* (2017) devises research capacities for the master's degree; notwithstanding, it states that a number of activities are to be fulfilled which undergraduate students are to learn during their college training, and which include the use of research methods, formulation, analysis and resolution of research problems. In another work, Ismuratova *et al.* (2018) say that the research capacity of college students is characterized by their participation in a series of different works: reports, reference documents, research works and projects, which imply dominion of modern search methods, processing and using information, as well as some scientific research methods.

On the other hand, Davidson & Palermo (2015) propose that teaching research capacities be included in the development of the curriculum in undergraduate courses and suggest the following learning results: designing a research survey, developing of a systematic review of literature, managing research projects, comparing research methodologies, applying qualitative and quantitative data analysis statistical methods, and communicating scientific literature results. Likewise, Tobon (2013) describes the main research capacities, which refer to reading and writing skills, managing information, autonomous learning, research and inquiry spirit, as well as solid study habits.

In the same context, Lagunes, Judikis & Flores (2016) propose capacities concerning nine knowledge aspects and 21 skills which a

college student ought to have. Those related with research capacities include: to identify problems of the research project, to make a qualitative and quantitative data analysis, to search for relevant information, to analyze and solve problems; to analyze, search for and evaluate information, among others. In the literature presented by Rivas (2011) there are nine capacities from the LART 2011 model. We believe it is necessary to restrict the skills at a college level aimed to propose the problem of research, to conduct a literature review, to learn data analysis techniques and to write scientific results. Table 1 summarizes the proposal made by these authors to determine research capacities.

Table 1. Summary of studies that propose research abilities

Name of the study	Author(s)	Research abilities
The students' research competences formation on the master's programs in Pedagogy	Emelyanova *et al.* (2017)	Research methods, formulation, analysis and solving of research problems.
Model of forming future specialists' research competence	Ismuratova *et al.* (2018)	Modern search methods, processing and use of information, good command of some scientific research methods.
Developing research competence in undergraduate students through hands on learning	Davidson y Palermo (2015)	Research study design, development of a systematic revision of literature, management of research projects, comparation of research methodologies, application of qualitative and quantitative data statistic method analysis, and communication of results of scientific literature.
Formación integral y competencias. Pensamiento complejo,	Tobón (2013)	Reading and writing abilities, information management, autonomous learning, research

currículo, didáctica y evaluación. [*Integral education and competencies.* *Complex thinking, curriculum, didactics and evaluation*]		and investigative spirit, and strong study habits.
Development of a research competence in university students through blended learning	Lagunes *et al.* (2016)	Identifying the problems of the research project, qualitative and quantitative data analysis, search of relevant information, problem analysis and solving, analyzing, searching and assessing information.
Las nueve competencias de un investigador [*The nine powers of an investigator*]	Rivas (2011)	Presenting the problem of the research, reviewing the literature, knowing data analysis techniques, and writing the scientific results.

Once the literature found in the bibliographic review has been analyzed, we have selected five research capacities we believe are basic for the learning process of college students, and which we describe below.

Managing bibliographic literature

One of the basic activities when performing a scientific literature review is to record and manage information. This task implies collecting, storing, recovering and managing all the information found in bibliographic searches. Substantiation of the contents of a manuscript with proper references plays a relevant role so that it may be accepted; in addition, managing bibliographic literature helps in tracking the origin of a survey or the methods adopted. Therefore, accuracy of references in manuscripts forwarded to magazines is a relevant contributing topic to the quality of bibliographic documents (Mueen & Al Dhubaib, 2011).

Searching for bibliographic information

The search for bibliographic information is a process which enables finding accurate and efficacious information intended to obtain proper results to the needs of information from among that large amount of existing documents. The type of resources to be inquired depends on the purpose of the search, for example, scientific magazines, congress proceedings, norms, documentaries, among others (Universitaria, 2013).

Processing and obtaining information

Obtaining trustworthy information is a valuable factor to develop true and actual research works. There are different techniques and instruments aimed to obtain information, which include observation, surveys, interviews, check lists, questionnaires, among others, and they all comprise a means to obtain the necessary information to fulfill the purpose of the survey (Leyva, Perez & Perez, 2018).

Descriptive and inferential statistics

The purpose of descriptive statistics is to summarize evidence found from a research in a plain and clear manner for interpretation. Different types of resources may be used such as charts and tables that allow us to interpret, to spot trends and to compare processed data (Rendon-Macias, Villasis-Keever & Miranda-Novales, 2016). In contrast, inferential analysis shall only be used for surveys to compare the results between two or more groups, or which establish changes in the same group (Flores-Ruiz *et al.*, 2017). Therefore, statistics, both descriptive and inferential, is in charge of examining a sample of the population with the purpose of collecting data and results that contribute to obtain results that may be employed in new surveys (Salazar, Castillo & Del Castillo, 2017).

Project analysis and investigation

The analysis and research process of a project may be made known in different manners, as referred by Bauer, Bleck-Neuhaus & Dombois (2010), which allowed us to achieve a correct focus, clearly defined objectives, transparent and realistic research design, a special manner to select scientific methods, as well as a work plan and use of resources; this makes it possible that a successful product may be finally obtained.

METHODOLOGY

In order to fulfill the objective of our research we followed three stages: to determine instructional strategies we are to apply, to design and to implement a VLE (which will be used as a tool to foster students' research skills), and to determine the improvement of research capacities of students partaking in the survey.

Determining instructional strategies

Instructional strategies are taken as actions which teachers ought to create during the teaching-learning process so that the construction of knowledge and the development of skills are optimal to instruct students (Tarango *et al.*, 2015). In our survey we took the publication of Pastor, Arcos & Gomez (2018) as basis, who describe learning theories which, in accordance with Wu *et al.* (2012), have had most influence in current education and, at the same time, theories of instructional design that would be provided within each learning paradigm. Table 2 summarizes the proposal of these authors.

Table 2. Learning theories and instructional design

Theories of learning	Theories of instructional design
Behaviorist	Direct instruction Programmed instruction Social learning
Cognitive	Attribution Theory Elaboration Theory Development Theory Theory of Conditioning
Constructivist	Problem-based learning Cognitive learning

	Discovery learning Case-based learning Situated learning Activity Theory Actor-Network Theory

From the fourteen instructional design theories mentioned by Pastor *et al.* (2018), we took four into consideration, which became strategies we implemented in the second stage. The theories are: direct instruction, social learning, discovery learning, and development theory; the first two are included in the behavioral theory; the third one, in cognitive theory; and the last one, in the constructivist theory, which we describe below. This information shall be used as the basis for designing and implementing VLEs, as this will contribute to the education of students and in strengthening of research capacities.

DIRECT INSTRUCTION

This is a unidirectional communication model based on classical teaching models, which considers that the teacher provides new knowledge to the student (Rafael & Salguero, 2009). The main purpose is that students learn, this commonly refers to a skill where the purpose is explained and how a specific activity is performed (Martin, 2007). For this model to work in the best manner, students shall commit directly in every area by making questions and by means of teacher feedback (Sanhueza, 2012).

SOCIAL LEARNING

This is a learning model where students learn after they saw a subject do it. The observant leans through different means, for example, through the senses (Cherem *et al.*, 2015). There are four processes in this kind of learning: attention, retention, production and motivation; in addition, this includes learning theories and personality.

DISCOVERY LEARNING

In this kind of learning, the teacher offers students the possibility of learning on their own; thus, the student strengthens his/her own knowledge from traditional teaching, where the teacher is the facilitator of knowledge. Discovery learning is a significant contributor to the learning process of college students (Eleizalde *et al.*, 2010).

DEVELOPMENT THEORY

This theory starts from the analysis of the structures of knowledge, as well as from the processes of learning theories. It presents most appropriate design models that are to be implemented, it fosters teaching systematically aimed to contribute to the reinforcement of and properly summarizing everything the student has learnt (Acaso, 1998).

Design and implementation of the virtual learning environment

With the purpose of improving research capacities and skills of college students, we designed a VLE by using Moodle Ver. 3.52, which is structured in five sections, each of which include a research capacity to be fostered. Each section of the room uses specific strategies in the previous section that are implemented by means of resources and activities available in Moodle.

The figure presents the structure in two sections of the VLE by way of example. Subsection a) of the figure is competence 1: managing bibliographic literature, where the "direct instruction" instructional strategy is applied through a didactic pattern to present the topic; subject objectives are detailed and then, a video is presented discussing the topic with specific aspects (objective, implementation), assessment tools and activities implemented in the practice.

Subsection b) of the figure is competence 2: processing and obtaining information, where the "development theory" instructional strategy is implemented, by means of presenting different components: webpages, book-type resources or wikis, discussion forums, assigned tasks, and assessment tests. A similar structure was used in the remaining sections of the VLE; in accordance with the specifications in Table 3.

Figure. Virtual classroom structure and implementation of instructional design strategies.

Table 3. Implementing instructional strategies to foster research capacities.

Research abilities represented in the VLE	Instructional strategy	Resources/activities
Management of source literature	Direct instruction	• Video • Discussion forum • Test
Processing and getting information	Elaboration Theory	• Webpage • Discussion forum • Videos • Assigned homework
Search of bibliographic information	Discovery learning	• Webpage • Discussion forum • Videos • Assigned homework • Wikis
Descriptive and inferential statistics	Elaboration Theory	• Webpage • Book resource • Video • Homework
Project analysis and research	Social learning	• Webpage • Didactic document • Discussion forum • Workshop activity

Assessment of research capacities

Data to assess the improvement of research capacities were collected by means of a virtual course, where 65 students were enrolled of the Systems Engineering degree of a university of Ecuador, during the September 2018-February 2019 period. Students selected were in the fifth, sixth and eighth semester of their bachelor studies, respectively, who were taking the subjects of Web Applications, Software Engineering and Thesis Design.

Enrolled students in the virtual course were submitted to the following process: evaluation of research capacities before starting the course (pretest), training students by means of the virtual classroom, and performance of every activity prescribed in the course, and evaluation of research capacities after having fulfilled the whole training (posttest). This process was completed by 54 students, that is, 83.1% of the students enrolled performed all the activities prescribed in this process and eleven were discarded from the evaluation process (see Table 4).

Table 4. Partakers in the virtual course

Subject	Number of enrolled students	Number of rejected students	Total
Web Applications	37	6	31
Software Engineering	15	3	12
Thesis Design	13	2	11
Total	65	11	54

The objective of the evaluation test was to determine the skill to develop research capacities by means of questions related to their course of studies. The text comprised 50 structured questions as follows: seven to assess bibliographic literature management competencies, 18 to assess descriptive and inferential statistics

competency, eight to assess processing and obtaining information competency, eleven to assess project analysis and research competency, and six to assess search and managing information competencies. Each correct question was evaluated on two points, that is, the full test had an evaluation score of 100 points; each evaluated competency was weighted as specified in Table 5.

Table 5. Number of questions of pretest and posttest and their weight

Research ability	Number of questions	Assessment (%)
C1. Management of source literature	7	14
C2. Processing and getting information	18	36
C3. Search of bibliographic information	8	16
C4. Descriptive and inferential statistics	11	22
C5. Project analysis and research	6	12
Total	50	100

Once the results from the pretest and the posttest were gathered, we applied Wilcoxon signed-rank test; this is a non-parametric test which allows us to compare the medium rank of the two related samples and to determine whether there are any differences between them. We also performed a statistical evaluation of the difference in the variables of interest among these groups by means of the Mann Whitney-U tests. The significance considered was $P<0.05$. This analysis was performed for each group and for all the students, as mentioned; the students who completed the three stages in the assessment process were included in the analysis and in the reported descriptive statistics for each competency assessed.

RESULTS

A total of 65 students were enrolled in the virtual course, eleven of which did not complete the programmed activities in the pretest, in the course or in the posttest: by contrast, 54 students completed all the stages which allowed us to assess the improvement in the development of research capacities.

Table 6 shows the analysis of the pretest and posttest results, of the students taking the subject of Web Applications (n = 31). We noticed there is a significant difference between the results of the two tests; in both cases, we calculated the interquartile range (IQR) which refers to each assessed capacity, that is, the difference of the median between the first and the third quartile of the results obtained, which we present as follows:

$$M(Q1,Q3)$$

where:

M = median of capacity under analysis

Q1 = median of first quartile

Q3 = median of third quartile

$$IQR = Q3 - Q1$$

Table 6. Results obtained for each group in the pretest and the posttest

Research abilities	PRETEST		POSTEST					
	Median (IQR)	Range	Median (IQR)	Range	P	Improved (N)	No change (N)	Decrease (N)
Group 1: Web Applications (N = 31)								
C1 / 14	8.34(7.6,8.9)	5.4 - 9.8	11.67(10.56, 13.50)	10.00 -	0.000	27	3	1

				14.00				
C2 / 16	11.45(9.57,12.56)	10 - 14	14.9(14.56,15.78)	12.45 - 16.00	0.000	25	1	5
C3 / 22	18.34(17.56,18.45)	16.45 - 19.56	21.56(20.56,21.87)	19.56 - 22.00	0.000	22	6	3
C4 / 36	31.67(30.37, 32.56)	27.56 - 34.87	35.67(34.98,35.89)	34.67 - 36.00	0.000	21	8	2
C5 / 12	9.67(8.78,10.45)	7.56 - 19.47	11.67(11.45, 11.90)	10.68 - 12.00	0.000	24	4	3
Group 2: Software Engineering (N = 12)								
C1 / 14	11.37(10.45,12.56)	9.67-1.90	13.72(13.58,13.98)	12.56 - 14.00	0.003	5	5	2
C2 / 16	13.21(12.47,14.56)	10.67 - 15.23	15.89(15.67,15.98)	15.23 - 16.00	0.002	7	4	1
C3 / 22	20.45(19.64, 20.64)	18.56 - 21.78	21.61(21.12, 21.95)	20.56 - 22.00	0.002	6	2	4

C4 / 36	31.61(30.58, 32.86)	28.00 - 34.67	35.72(34.61 ,35.87)	33.46 - 36.00	0.002	8	3	1
C5 / 12	10.53(10.33, 10.79)	9.56 - 11.56	11.63(11.45, 11.83)	10.56 - 12.00	0.002	7	3	2
Group 3: Thesis Design (N = 11)								
C1 / 14	10.23(9.56,12.56)	9.40 - 13, 67	13.56(12.56 ,13.87)	12.45 - 14.87	0.004	6	3	2
C2 / 16	14.67(13.67,14.78)	13.50 - 15.90	15.67(15.34, 15.78)	14.67 - 15.98	0.004	9	0	2
C3 / 22	20.56(20.45, 21.56)	20.13 - 21.98	21.68(21.67 ,21.98)	21.56 - 22.00	0.007	6	4	1
C4 / 36	31.45(29.05, 33.56)	27.00 - 34.87	35.78(34.89,35.90)	32.56 - 36.00	0.003	8	1	2
C5 / 12	9.99(9.67,10.34)	9.34 - 11.76	11.72(11.09, 11.89)	10.67 - 12.00	0.003	7	2	2

For example, in the literature management capacity, there is a pretest IQR of 8.34 (7.6, 8.9) = 1.3 and a posttest of 11.67 (10.56, 15.50) = 2.94, which means that, in the first case, 50% intermediate of data is 1.3, and in the second, 2.94, with a P = 0.00, comprising a significant difference in this capacity.

Table 7. Summary of results for each research competency and group under study

Table of results	Assessment /100	N= 54 student		
		A PRETEST	B POSTEST	A-B
		Median	Median	
Group 1: Web Applications (N = 31)				
Management of source literature	14	8.02	11.95	3.93
Processing and getting information	16	11.38	14.93	3.55
Search and management of information	22	18.18	21.30	3.12
Descriptive and inferential statistics	36	31.60	35.50	3.9
Project analysis and research	12	10.20	11.63	1.43
Group 2: Software Engineering (N = 12)				
Management of source literature	14	11.49	13.68	2.19

Processing and getting information	16	13.30	15.78	2.48
Search and management of information	22	20.31	21.51	1.2
Descriptive and inferential statistics	36	31.63	35.25	3.62
Project analysis and research	12	10.56	11.55	0.99
Grupo 3: Thesis Design (N = 11)				
Management of source literature	14	10.81	13.30	2.49
Processing and getting information	16	14.50	15.56	1.06
Search and management of information	22	20.91	21.79	0.88
Descriptive and inferential statistics	36	31.12	35.20	4.08
Project analysis and research	12	10.12	11.53	1.41

In accordance with the results in table 7, every group of study has had significant improvements on the five capacities under analysis, since $P < 0.05$.

In Group 1, there is evidence that the best evaluated capacity is C1 management of bibliographic literature, with an improvement of 3.93 points and the lowest evaluation is for C5, project analysis and research, with an improvement of 1.43 points. Group 2 shows that the best evaluated capacity is C4 descriptive and inferential

statistics, with an improvement of 3.62, and the lowest evaluation is for C5 project analysis and research, with an improvement of 0.99 points. In Group 3, we noticed that the best evaluated capacity is C4 descriptive and inferential statistics, with an improvement of 4.08 points, and the lowest evaluation is for C3 search and management of information, with an improvement of 0.88 points.

The low improvement of capacity C5 in the first two groups could be the reflection of scarce academic instruction of students in the topic of project development and management, which is included in the seventh and ninth semesters. The low improvement in capacity C3 for group 3 was expected, as this capacity was correctly evaluated in the pretest and the improvement range is close to the upper limit in the posttest.

Table 8 and the chart contain results from processing calculation of the means of the 54 students who partook in the study. It is concluded that the best evaluated capacity is C4, descriptive and inferential statistics, with an improvement of 3.87 points, and the lowest evaluation was C5 project analysis and research, with an improvement of 1.33 points.

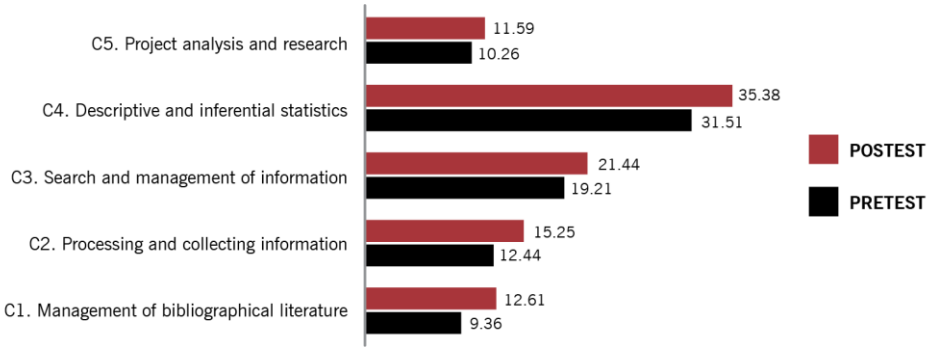
The results are evidence that the activities performed by the students in the VLE contributed to strengthen all the research capacities. In table 8, we can see that the means of the posttest of these capacities are close to the upper value set forth in the weighing. We also noticed the benefit of the knowledge provided by the VLE regarding descriptive and inferential statistics, taught in the fourth semester of their bachelor's course of study and which tends to be left out in subsequent semesters.

Table 8. Summary of results per research capacity

Research capacities	Assessment /100	N= 54 students			
		A PRETEST	B POSTEST	A-B	P
		Median	Median		

C1. Management of bibliographical literature	14	9.36	12.61	3.25	0.000
C2. Processing and collecting information	16	12.44	15.25	2.81	0.000
C3. Search and management of information	22	19.21	21.44	2.23	0.000
C4. Descriptive and inferential statistics	36	31.51	35.38	3.87	0.000
C5. Project analysis and research	12	10.26	11.59	1.33	0.000
Total	100	82.78	96.27	13.49	

Chart. Comparing final results of the pretest and the posttest



CONCLUSIONS

In our survey we have analyzed five research capacities that are paramount in the learning process and that are to be developed by pre-degree students: bibliographic literature management, bibliographic information search, information process and collection, descriptive and inferential statistics, and project analysis and research. In order to foster their improvement, we have structured a virtual course based on four instructional strategies: direct instruction, social learning, discovery learning, and development theory, which were implemented by means of activities and resources available in Moodle.

A total of 54 students were trained in the virtual course and completed the whole planned process. The results show that all the research capacities have had a significant improvement when students are instructed in virtual classrooms using selected instructional strategies. There is a global improvement in the application of research capacities of 13.49%, among these, C4 Descriptive and Inferential Statistics, with the higher improvement percentage.

The purpose of developing research capacities ought to be encouraged by means of instructional strategies in tune with the research teaching mode by using VLEs, in such a way that these capacities become a comprehensive part of college students, that may later be applied to post-degree studies and contribute to the solution of social problems and the surroundings thereof.

We could extend the five proposed research capacities in this work, if we consider that their field of application is pre-degree students and that teaching them was in a virtual mode; however, we have to consider that, for the post-degree level, we ought to examine other research aspects and characteristics oriented to developing scientific research capacities. Furthermore, we could analyze supplementary instructional strategies to those used in our survey, which opens up a perspective to represent a same research capacity or skill with different techniques.

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