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Learning strategies and digital educational resources for the development of research competence: protocol of a systematic review

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 17 June 2023 and was last updated on 17 June 2023.

INTRODUCTION

Review question / Objective The question that led to the systematic review was: What are the methodologies and digital educational resources that benefit the development of research competence in higher education students?

This allowed formulating the following general objective: to identify the methodologies and digital educational resources that benefit the development of research competence in higher education students. This objective was further specified in the following specific objectives:

- Analyze scientific production on didactic strategies and digital educational resources in higher education contexts.
- Determine the teaching-learning strategies and digital educational resources used in the development of research competence in higher education students.
- Identify the benefits provided by didactic strategies and digital educational resources used in the development of research competence in higher education students.

Rationale The development of research competence in higher education students has become a challenge in the curricula defined by different academic programs. However, studies reveal the deficiencies that university students present in knowledge related to research methods, as well as the limited applicability and usefulness of these methods, which are often seen as boring and abstract topics (Reid, 2018). This reality highlights one of the main concerns of the higher education system: the lack of research skills and competencies among students, which is reflected in the scarcity of scientific research outputs during and after their studies (Ávalos et al., 2019). In response to this situation, governments and education administrations have implemented various actions aimed at specialized centers, innovation centers, and mostly universities, in order to achieve scientific excellence (Organization for Economic Cooperation and Development [OECD, 2016]). The goal is to ensure greater integration of students in investigative processes, which would have a positive impact on their own professional and academic practice, as well as on

the specific indicators of institutions and reference countries.

In line with this, numerous pedagogical models and strategies have been employed to promote transversality in academic programs and respond to continuous social changes (Chávez et al., 2022). In this regard, the most active teaching-learning methodologies are those that enable a more constructive acquisition of knowledge, attitudes, and skills conducive to research planning and implementation, as well as the optimal development of leadership, autonomy, cooperative teamwork, empathy, and effective communication skills. Likewise, digital educational resources serve as support and/or complement both inside and outside the classroom, providing an ideal means to promote experiential learning. Identifying the most commonly used strategies and resources for the development of research competence in higher education is the starting point for their optimization and applicability.

Condition being studied Research competence can be seen as a set of concepts, skills, attitudes, and learning strategies aimed at implementing the phases and activities that constitute the research process. These elements encompass problem-solving, quantitative and qualitative data analysis, information search and management, research methods, leadership, collaborative-cooperative teamwork, and both oral and written communication skills. However, in some cases, these skills are not adequately developed in higher education students, which motivated this study.

METHODS

Search strategy To define the search strategy, a series of terms and descriptors were initially considered and grouped into the following categories: 1) Research skill o competences: research skills, research problem solving, research competences, quantitative analysis, qualitative analysis, research communication skills, research written communication, research oral communication, research methods and research methodologies. 2) Strategies: research Projects, research training, cooperative learning, active learning, associative learning, service learning, research strategies, research didactic strategies, experiential learning, design-based learning, project learning, problem-based learning, mobile learning and case study learning. 3) Digital learning resources: technological research resources, virtual learning objects, multimedia instruction, multimedia, social networks, virtual course and digital application 4) college, university, undergraduate, higher education, post-secondary,

tertiary institution, tertiary education and third level education

Next, an equation was constructed for each of the specialized databases ERIC, SCOPUS, and WOS. The descriptors were combined in different ways according to the requirements of each database. The three search equations included Boolean operators, expansion, interval, qualification, and chaining operators to improve the search process and ensure more accurate results. Below is the search equation used for the ERIC database:

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((MJMAINSUBJECT.EXACT("Research Skills") OR MJMAINSUBJECT.EXACT(" Research Problem Solving") OR noft("research skills") OR noft("Research competenc*") OR noft("Quantitative Analysis") OR noft("qualitative analysis") OR MAINSUBJECT.EXACT(" Research Communication Skills") OR noft("Research communication written") OR noft("Research communication oral*") OR noft("research method") OR noft("research methodologies") OR noft("research methodology") OR noft("research methods") NOT ( "High school" ) NOT ( "Primary school" ) NOT ( "systematic review" ) NOT ( "Bibliometric review" ) NOT ( "Masters" ) NOT ( "Doctorate?" )) AND ((MAINSUBJECT.EXACT.EXPLODE("Research Projects") OR MAINSUBJECT.EXACT.EXPLODE ( " Research Training " ) OR MAINSUBJECT.EXACT.EXPLODE("Cooperative Learning") OR MAINSUBJECT.EXACT.EXPLODE ( " Active Learning " ) OR MAINSUBJECT.EXACT.EXPLODE("Associative Learning") OR MAINSUBJECT.EXACT.EXPLODE ("Service Learning") OR noft("Research strateg[*3]") OR noft("Research didactic strateg[*3]") OR noft("Teaching research strateg[*3]") OR noft("Experiential learning") OR noft("Design-based learning") OR noft("Design based learning") OR noft("Project learning") OR noft("Problem-based learning") OR noft("Problem-based learning") OR noft ( "Mobile learning" ) OR noft("Case study learning") NOT ( "High school" ) NOT ( "Primary school" ) NOT ( "systematic review" ) NOT ( "Bibliometric review" ) NOT ( "Masters" ) NOT ( "Doctorate?" )) OR (MAINSUBJECT.EXACT.EXPLODE("Educational Resources") OR noft("Technological research resources") OR noft("Virtual learning objects") OR MJMAINSUBJECT.EXACT("Multimedia Instruction") OR noft("multimedia") OR MAINSUBJECT.EXACT("Social Networks") OR noft("virtual couse*") OR noft("Digital application*") OR noft("escape room*") OR noft("break out") NOT ( "High school" ) NOT ( "Primary school" ) NOT ( "systematic review" ) NOT ( "Bibliometric review" ) NOT ( "Masters" ) NOT ( "Doctorate?" )))) AND (MAINSUBJECT.EXACT.EXPLODE("Undergraduate Students") OR noft("undergraduate student") OR
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noft("undergraduate students") OR noft("undergraduat*") OR noft("graduat*") OR noft("student* ") OR noft("pre graduat*") OR noft("pre-graduat*") OR noft("Higher education") OR noft("higher educated") OR noft("higher education") OR noft("higher educational") OR noft("higher educations") OR noft("Post-secondary") OR noft("postsecondary ") OR noft("Tertiary institution") OR noft("tertiary education") OR noft("tertiary student") OR noft("tertiary students") OR noft("tertiary studies") OR noft("tertiary study") OR noft("tertiary institute") OR noft("tertiary institutes") OR noft("tertiary institution") OR noft("tertiary institutions") OR noft("Third level educat*") OR noft("third level stud*") OR noft("universit*") OR noft("college") NOT ("High school") NOT ("Primary school") NOT ("systematic review") NOT ("Bibliometric review") NOT ("Masters") NOT ("Doctorate?")).

Participant or population Higher education students.

Intervention The intervention focused on identify the strategies and educational resources used to develop research competencies in higher education students, as well as its benefits.

Comparator No comparators were required.

Study designs to be included The review included studies with a quantitative and qualitative approach and mixed methods.

Eligibility criteria The review was based solely on scientific articles published in journals indexed in the ERIC, SCOPUS, and WOS databases. Grey literature, conference proceedings, or book chapters were not included. The inclusion criteria were as follows: articles that involved research with higher education students, presented results from empirical research, manifested an educational purpose of teaching and learning, reflected the learning strategies and digital educational resources used for the development of investigative competencies and skills, demonstrated the benefits of these strategies or resources, were published between 2017 and 2022, and were available in English or Spanish. The exclusion criteria included articles that referred to non-formal education (continuing education courses, MOOCs, diplomas), focused on the development of competencies of higher education teachers, had a theoretical nature and/or systematic reviews, studied postgraduate populations, or reflected students' perceptions of a specific strategy or resource.

Information sources The bibliographic sources consisted of scientific articles found in the ERIC, SCOPUS, and WOS databases.

Main outcome(s) A total of 20 eligible studies were identified. The bibliometric analysis revealed that the highest scientific production was concentrated in 2017 and 2018, with five studies each year (25%), while the years 2021 (k = 2, 10%) and 2022 (k = 0) had lower scientific production. The selected studies focused on the following areas: Administration (k = 1), Education (k = 6), Engineering/Urban Design (k = 2), Music/Arts (k = 1), Psychology (k = 3), Health/Medicine/Bioethics (k = 3), Sociology/Social Work (k = 3), and unspecified area (k = 1). In terms of geographical origin, empirical research was conducted with students from Australia (k = 1), Saudi Arabia (k = 1), Brazil (k = 1), Korea (k = 1), United States (k = 8), Ecuador (k = 1), Spain (k = 2), Indonesia (k = 1), Thailand (k = 1), Taiwan (k = 1), and Turkey (k = 2). Based on the results obtained, problem-based learning was identified as the most employed didactic strategy for promoting research competence, facilitating understanding of the inquiry process and related concepts, research planning and organization, and the development of various research skills such as problem-solving. Three studies identified specific digital educational resources used in the development of research competence. One of them highlighted social media as a useful tool for acquiring skills related to quantitative data analysis, oral communication, and research methods.

Additional outcome(s) The systematic review identified the benefits of various didactic strategies on different skills associated with research competence in higher education students. Therefore, the importance of applying active learning methodologies based on students' own research is emphasized. Practical and experiential learning, knowledge construction, and critical and collaborative reflection are essential elements of the examined procedures.

Data management All studies resulting from the search were controlled using the Mendeley reference manager. A coding form inspired by the PRISMA Protocol was used for recording selected and non-selected works, and Microsoft Excel was employed for data management.

Quality assessment / Risk of bias analysis For each study resulting from the search, the following process was followed: 1) Title and abstract review: the potential inclusion of each work was evaluated based on an analysis of these sections; 2) Full-text

review: once the studies from the first phase were selected, the full text was read, with emphasis on the results, discussion, and conclusions. The reviews were conducted independently by the authors, and consensus was reached for the inclusion of the studies.

Strategy of data synthesis Two approaches were used for data synthesis. In the quantitative approach, information was generated through the application of univariate descriptive statistics (frequencies) concerning the strategies and technological educational resources used. These calculations were performed using Microsoft Excel version 2019. Additionally, a thematic relationship graph was generated to represent the initial search (prior to inclusion and exclusion criteria) using VOSviewer version 1.6.18.

Regarding the qualitative approach, the benefits of the strategies and digital resources employed were described based on a content analysis of the authors' insights from the selected documents.

Subgroup analysis Not used.

Sensitivity analysis Not used.

Language restriction Only studies in English and Spanish were considered.

Country(ies) involved Colombia and Spain.

Other relevant information As a result of the review, it was observed that active learning enables a better understanding of processes related to experimental research, significantly enhances general research skills, and promotes improved performance in topics related to research methods. All of these are benefits for the development of research competence.

Keywords Research competence; research skills; learning strategies; educational technology; higher education.

Dissemination plans The findings will be published in an peer-reviewed journal.

Contributions of each author

Author 1 - Magle Virginia Sanchez Castellanos - Author 1 was in charge of: posing the initial question and objectives, analyzing the theoretical bases and identifying all the descriptors, design the search equation in the three databases, filter and analyze the articles, manage the the data, perform data analysis and write the final report. Email: magle.sanchez@campusucc.edu.co

Author 2 - María Isabel Gómez-Nuñez - Author 2 was responsible for: reviewing the initial question and objectives, reviewing the search equation in the three databases, analyzing the articles, selecting eligible articles, reviewing the data analysis, and reviewing the final report. Email: mariaisabel.gomez@unir.net