



Research Article

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Received: 18 March 2023 / Accepted: 29 April 2023 / Published: 5 May 2023

Interdisciplinary Formative Research in the Undergraduate-Graduate Field: Definitions, Perceptions and Proposals

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DOI: <https://doi.org/10.36941/jesr-2023-0054>

Abstract

The purpose of the study was to determine the main definitions, perceptions and proposals of interdisciplinary formative research in the university field at the undergraduate level. Among the most used methods are: bibliographic exploration, selection criteria, data retrieval and evaluation of the quality of selected articles. In this sense, it was possible to obtain 25 definitions of formative research (Scopus base) and 16 in Scielo. From 41 studies analyzed, 36 of them facilitated the extraction of perceptions, mainly categorizing four main ideas: curricular policy, formative and investigative vision, investigative culture and research trainer. Likewise, in 10 articles of the total reviewed, proposals stood out, especially four experimental researches, oriented to improve scientific skills. In conclusion, formative research, from and for university classrooms, considered in the training of professionals for the different disciplines, becomes a fundamental strategy, as a learning method, useful in didactics, systematic preparation and orients the rethinking of university curricula; highlighting its transversal nature and interdisciplinary character in order to promote research skills and the training of researchers according to the graduate profile; finally, to respond to the problems and emerging needs of the surrounding community.

Keywords: research, learning method, research training, curricula

1. Introduction

In the context of this study, formative research (FI) is consolidated as a strategy par excellence to promote inquiry competence in students at different levels and modalities, especially at the

university stage. Its approach integrates in a transversal way the pedagogical and curricular components, with the purpose of training people capable of solving problematic situations in their field and benefiting in great dimension, not only the rigorous production of knowledge, but also the formation of competent professionals. These statements are supported, on the one hand, by Turpo et al. (2020), who stated that didactic inquiry stimulates exploration, enunciation of problems, deliberations, etc., i.e., it allows students to become actively involved in research processes. For his part, Castaño (2019) reveals that the true meaning of the variable subject of analysis is to accompany, instruct and support in and for exploratory activities. Asis et al. (2022) also state that formative research is a methodology specific to higher education, which improves capacities for scientific research and involves educational actors from the curricular component. Undoubtedly, the coincidences reside in the pedagogical action of university teaching, favoring strategically, above all, the advances in research and production of scientific knowledge.

Continuing with the analysis, and delimiting that the research component is crucial in the training of future professionals with high levels of achievement and effectiveness, there are many works referring to formative research, however, few delimit accurately the academic and inquiry level. This information is supported by the works of Vera et al. (2018), Hernández et al. (2021), Gómez-Escorcha et al. (2020) and Venegas et al. (2019), who mentioned that undergraduate training in Peruvian and Latin American universities is still lacking. As a result of the low priority given to formative research as a strategy, there are great weaknesses with respect to inquiry competencies in undergraduate students.

In accordance with the above, it is certain that the university institutions in the Latin American region do not currently consolidate formative research, a situation reflected in the limited scientific production by the direct actors. The problem in Peru is also related to the limited number of people dedicated to research and research professors qualified by Concytec (The National Council for Science, Technology and Technological Innovation). According to the Registry of Researchers (Concytec, 2023), there are 5657 active professionals, of which 1302 are dedicated to the area of medical and health sciences, 1032 producing for the social sciences, while 261 declare humanities as their line of research. Although the figures may not be directly linked to pedagogical action and formative research, they reveal in a certain way the little involvement of professionals in general in the production of knowledge, a reality that confirms the imperative need for this approach.

In order to focus on the reasons why the work is carried out, in the study of the art, two studies stand out and coincide in finding deficient levels of research skills among undergraduate students (Hernández and Yallico, 2021; Pástor et al., 2020). Hidalgo (2022), meanwhile, asserts that the problem stems from the weakness of curricular plans, the lack of use of technologies for research and the reduced number of research teachers, including those dedicated to thesis subjects who lack research activity and do not have scientific production. From these affirmations, it can be ratified that the scarce development of formative research in undergraduate, leads to a lack of inquiry competence, and the concern is to revert this reality by originating sustainable innovations for teaching and curriculum management.

Thus, it is inferred that research training is still in the process of growth, despite the existence of policies, procedures, regulations on research management in force, development and innovation at the level of institutions. Furthermore, Gómez-Escorcha et al. (2020), Díaz and Cardoza (2021) concluded in their explorations that there is an unfavorable attitude towards learning opportunities in research aspects and recommend strengthening the research culture through programs and institutional networks. The foregoing is an element that justifies the scope of the present study. In view of this, it is likely to warn of the negative consequences of not addressing the problem in a timely manner, a situation that would be transferred from the undergraduate university context to the subsequent stages after graduation, whether in the exercise of the profession or in postgraduate programs.

In short, there is no doubt that, if the central problem is not solved, it is possible to maintain in imbalance one of the main functions of university work; the research component. Therefore, it is imperative to approach and through the theoretical review contribute to enhance formative research,

knowing that there is still a gap of knowledge to be covered in this area. In this environment, the question arises: Is there enough epistemic support for formative research? In the present study, the main definitions, perceptions and proposals with scientific character, which contribute to the inquiry competence in undergraduates, were determined.

2. Methodology

A systematic review study related to interdisciplinary formative research was carried out, focusing on the main theoretical definitions, main perceptions and relevant proposals. This design starts first of all with a research question, then the information is analyzed and systematized under a regulated and reproducible method (Torres-Fonseca and López-Hernández, 2014).

In the context assumed, the research work consisted of five procedures: first, the systematized question was posed, followed by a search in a high-impact database. This was followed by the selection of articles, data extraction and, finally, qualitative-quantitative analysis. The third process is precisely explained in the attached figure.

Table 1. Article selection: Steps

1. Search in scientific literatura; Database: Scopus- Scielo; Search for abstracts.	
2. Combined search results (n= 2365)	Duplicates removed (n= 400)
3. Articles filtered by title and abstract (n=84)	Excluded records after filtration (n=24)
4. Full-text articles evaluated for eligibility (n=60)	
5. Manuscript review and application of inclusion criteria	
6. Excluded(n=19)	
7. Studies included in the systematic review(n=41)	

Regarding data collection, bibliometric indicators were also considered, with a descriptive-retrospective method, considering as the unit of analysis, scientific publications in indexed journals during the mentioned period. From this perspective, Gallegos et al. (2020) argue that the method in question facilitates the selection, organization and categorization of data from a quantitative-qualitative viewpoint, whose main purpose is to identify the quantity and quality of scientific sources on a particular topic. To concretize this process, we used the checklist (see table 1) proposed by Romo-Martínez (2015) oriented to the critical analysis of articles (LcotAC) and adapted from the Spanish Critical Reading Skills Program (CASPe).

Table 2. Indicators of critical analysis of articles

Reagents	
Evidences the research question	The results are in line with the research objectives.
Evidences the research objectives	The discussion of the results is specified
The objectives are related to the research question.	The conclusions are in line with the research objectives.
The sample used is specified	An updated bibliography is evident
The type of article is oriented to the objectives of the research.	The most relevant research is shown in the bibliography.
The methodology applied is appropriate for the research objectives.	It is evident that the recommendations are aligned with the findings of the study.

Note. The indicators were evaluated with 1(yes) and 0(no), which were used to determine the degree of quality (only those articles with a score ≥ 7 were accepted as valid).

Finally, the processing was not limited to the selection and analysis of the information, but an interpretation was made based on previously established criteria (when making inferences and in the

generation of new information). This made it possible to identify, distinguish and organize the information after data triangulation; it was consulted in order to give an account of the current state of the FI, according to the categories of the study. In this line, a deep analysis was carried out, which implies crossing data, methods and theories, as pointed out by Muriel (2018).

3. Results

The review has made it possible to concentrate the main concepts, perceptions and proposals that authors have written about formative research from different disciplinary fields. Along these lines, the following tables systematize the findings. To begin with, transcendental definitions on FI will be observed, highlighting 25 found in Scopus and 16 in Scielo. It should be noted that, of the conceptions shown, two are the prevailing approaches; the first is research-oriented and the second is conducive to academic training (see Tables 3 and 4).

Table 3. Definitions of formative research in published Scopus articles

Quote	Definition	Quote	Definition
Campos-Ugaz et al. (2022)	FI as a practice develops competencies for research with benefits in the school-professional, academic-labor, social-economic environment, because it trains in useful competencies to provide solutions to problems in their environment.	Ramos et al. (2022)	Set of concepts and appreciations mastered by the teacher in order to strengthen disciplinary knowledge, through the implementation of the strategy as a process, both for teacher training to solve phenomena in practice, as well as for the generation of new competencies in students and finally the production of scientific knowledge.
Hidalgo (2022)	Knowledge and strategy, in the curriculum, so that it serves in the student's learning to learn, with the support of research skills progressively forming, the same that facilitate the assimilation of knowledge with activities ranging from the search for sources, problem posing, application of research methodology, cultivation of critical reasoning and generating solutions in different space and time.	Cortina et al. (2022)	Three concepts are assumed: 1) It is a didactic strategy useful in the preparation of students with research competencies. 2) It is a participatory action research method that promotes healthy behaviors in the nursing context. 3) It is a strategy that allows knowledge to be generated and applied to solve practical problems.
Almonacid and Fernandez-Maroto (2022)	It is a methodological approach organized on the basis of a multidisciplinary and merged approach. Meaningful learning formula.	Esparza-Reyes and Morales-Trapp (2021)	They are committed to it becoming an active teaching-learning process, a methodological strategy or a useful tool in the acquisition of knowledge.
Mejía and Velásquez, (2021)	It means to instruct, accompany and support in, and for exploratory activities, with the mere purpose of involving the student in the active construction of his learning, through the search for information, reflection and analysis by means of an instruction oriented to the solution of problematic realities in the different professional fields.	Alonso et al. (2021)	It is a useful strategy that involves developing skills for the design, implementation and use of tools to improve practice.
Álvarez et al. (2021)	It is seen as a classroom learning process, it stimulates the development of an inquiring culture in the student, enabling him/her to discover scientific findings, enhancing skills and interests in relation to research and strengthening other learning capabilities.	Beltrán et al. (2021)	It integrates the pedagogical realization, curricular structuring and mechanisms of surveillance, monitoring and control of the teaching processes; thus maintaining orderly processes that link knowledge, talents and technical dispositions. In other words, it is a joint strategy.
Castro-Rodríguez (2021)	Achieves knowledge in an autonomous and strategic way; related to the formation of academic, research and professional competencies.	Escalada and Pérez (2021) Cardoza-Sernaqué et al- (2021)	It uses technological resources for university students' training activities.
Rodríguez-Vargas et al. (2020).	It is conceived as the strategic axis for human and sustainable development.	Velandia-Mesa (2020)	It is to train for educational research, it aims to understand phenomena and processes through reflection. To develop it means to submit experiences to constant reevaluation. It considers the essential questioning directed with the capacity of service to the resolution of problems.
Escobar (2020)	Inspired by the attention to specific problems, the FI is a component of the curricular organization by competencies that must necessarily have a sense of cooperation among the actors of the university environment.	Salas-Ruiz (2020)	Dynamic relationship between students and teachers in the process of curriculum development of a program that energizes student learning, as it renews pedagogical practice in teachers. It is based on the four pillars of education (learning to know, learning to be, learning to do and learning to live together) and develops critical thinking, interest in discovering new knowledge. The FI is able to align learning strategies such as problem-based learning, journal club, design of inquiry projects, theoretical essay, monograph, integration of students to research projects with their teachers and research pre-seminar.
Arenas et al. (2020)	Improves academic processes, combines teaching and research, promoting competencies and research culture, as significant learning.	Rivas-Díaz (2020)	It is the transversal axis of the curriculum and its importance is centered on the spaces "research workshops" and "knowledge construction".
Rodríguez-Vargas et al. (2020).	It is conceived as the strategic axis for human and sustainable development.	Molina et al. (2019)	It contributes substantial elements to the different disciplines. From a critical and reflective view of the problems, it seeks to transform the social, economic, political and cultural reality.

Quote	Definition	Quote	Definition
Cortés et al. (2019).	Process of scientific initiation that the institution has defined within the research policy, articulating the lines of research with the programs: a wealth of knowledge and socially shared experiences, in order to sustain existing research and generate new niches of study among students.	Zúñiga and Duarte (2019).	Fundamental mechanism in the development of critical thinking of professionals and training for research, also linked to the capacity for lifelong learning, the search for problematic situations and possible solutions in the field of their profession. It is demanding for the university professor to adopt a different posture in view of the fact that knowledge possesses complexity, dynamism and progressiveness, where the student recognizes and accepts his potentialities to assume the responsibility of being the protagonist of his learning: assuming the role of researcher-learner agent.
Vergara et al. (2018)	It is a fundamental process for academic programs and student training.	Patíño et al. (2018).	The purpose of formative research is to provide comprehensive teaching from and for university classrooms. The main objective is to train researchers.
García, et al. (2018).	This type of inquiry allows students to foster their creativity, autonomy, critical thinking, collaborative learning and broaden their interdisciplinary knowledge, ensuring the formation of professionals with communication and research skills that respond to current needs.	Florez et al. (2018)	It is considered human and integral formation, protagonist of the processes of development and social transformation, which allows the university to be a forger of transforming subjects, generators of socially useful and transferable knowledge. It is certainly not an easy task, among educational interactions, theories, principles, pedagogical and curricular models, to promote research culture, especially to reach the application of its results.

Note: The definitions in this study have been considered as clear and accurate explanations of the general and differential characteristics of formative research.

Table 4. Formative research- analysis of published articles Scielo

Quote	Definition	Quote	Definition
Montes-Iturrizaga and Arias (2022)	Pedagogical procedure for the use, creation, adaptation and generation of innovations in response to the challenges of the environment. In addition, it promotes the systematization of experiences through the generation of relevant and close knowledge that it gathers from its pedagogical practice.	Pardo-Rozo (2022)	It is the pedagogical, curricular and didactic process directed to the production of knowledge and innovation, through the formation of critical people, with scientific character, capable of debating aspects of their reality and promoting the strengthening of the field where it is developed.
Juarez and Torres (2022)	Didactic process that develops basic research skills in undergraduates, prior to the approach of a research for degree purposes.	Castro-Rodríguez (2022)	Strategy to promote the development of research competencies and social projection activities. It is possible to develop it through research seedbeds (SI) which favor technological and social advances, forming critical and scientific professionals.
Álvarez et al. (2022)	Mechanism to enhance performance in the university formative context that consists of forming habits, skills and abilities as a basis to face greater difficulties in the professional field; it prepares to act in research with another level of transcendence and scope in the labor exercise.	Colás and Hernández de la Rosa (2021)	Related to the acquisition of complex learning skills which are part of scientific or research competencies. Complex skills such as problem solving, (scientific) reasoning, decision making, creativity, innovation, information, literacy, argumentation and critical thinking. This is the current challenge of society and education in international university systems.
Esteban et al. (2021)	All FI is research training, but this is not always FI. The purpose of FI is more pedagogical than to generate new knowledge. Both concepts are similar and at the same time have differences. FI is training in research and for research, with logical research activities that apply research methods, but do not necessarily imply obtaining new and universal pedagogical knowledge; that is, the development of research projects remains at an exploratory level.	Rodelo et al. (2021)	Regarding research training and the development of research competencies: IF is the process of learning by doing, where the student is actively involved in acquiring skills to search for information, reflect on it and analyze it, thus achieving the construction of his or her own knowledge.
Chuíco et al. (2021)	Institutional innovation in the higher education system where the structure of regulated research strengthens the classical mechanisms and contributes to external control and academic self-organization.	Ponce et al. (2021)	It projects research on future learning scenarios integrating pedagogical possibilities of the personal, social and institutional learning environment. Specifically, it leads to the definition of teaching-learning methodologies for new integrated virtual environments, spaces of greater openness that give rise to innovation.
Mirabal et al. (2020)	Practice associated with teaching research (both to give scientific relevance to teaching and to accustom students to the research logic and initiate them in this exercise) and doing research (production or systematic generation of knowledge, application of this knowledge to solve environmental problems).	Espinoza (2020)	This type of inquiry allows students to foster their creativity, autonomy, critical thinking, collaborative learning and broaden their interdisciplinary knowledge, ensuring the formation of professionals with communication and research skills that respond to current needs.
Turpo et al. (2020)	A set of strategies such as the formation of research groups, teams and research groups in which scientific knowledge is built and researchers are trained; IF is the foundation and mission of universities. Specifically, it lays the foundations for the critical and reflective, in order to master approaches, methods, techniques to pose problems, theorize and communicate results as part of research exercises.	Perez et al. (2020)	About through educational action, relate to disciplines in the field of epistemology and research methodology training; facilitating students to acquire knowledge and skills, useful skills in the approach of problems, supported by the management of information and communication technologies (ICT). This allows them to develop research processes during their academic preparation, but also in their future professional performance.
Barrios et al. (2019).	It differs from traditional research training because it emphasizes practice and not theory. It is learning by doing in contact with diverse realities and transferring the knowledge learned. It assumes research training in parallel; both are focused on providing the basis for understanding and managing methodological processes, but formative research is oriented to the promotion of a research culture and to train researchers.	García et al. (2018).	It is to train in and for research. An instrument of the teaching-learning process that forges knowledge, abilities, skills and attitudes so that the student can face research tasks that go beyond academic environments. It is guided by a teacher, and the participants are not expert researchers but subjects in the formative process.

Note: The definitions in this study have been considered as clear and accurate explanations of the general and differential characteristics of formative research.

Following are the perceptions inferred from the review of 36 selected concepts, of which eight (8) meanings are categorized: First, researcher trainer (two dates 2022 and 2018, one 2019); second, formative and research vision (two for the years 2022, 2021 and 2020, one for 2019); third, formative vision (2022 and 2018); fourth, research vision (one for the year 2019, 2020, 2022 and two 2021); fifth, favorable attitude to research (2022); sixth, research culture (two 2021, two 2020, one 2019); seventh,

quality management (2021); and finally, curriculum policy (two 2022, three 2021, four 2020 and one 2018). The time criterion allows identifying that the subject under study presents recent production, the frequency of publications with updated information dates tendentially in the last three years, however, it is still not enough to obtain clarity on how to define formative research because the perceptions obey the adjustments of the realities, disciplines and advances in university education worldwide (see Table 5).

Table 5. Perceptions found on formative research

Authors	Mixed perceptions	Authors	Mixed perceptions
Campos et al. (2022); Zúñiga and Duarte (2019); Patiño et al. (2018); García, et al. (2018); Castro-Rodríguez (2022).	Researcher trainer	Alvarez et al. (2021); Ponce et al. (2021); Arenas et al. (2020); Espinoza (2020); Barrios et al. (2019).	Research culture
Ramos et al. (2022); Castro-Rodríguez (2021); Cortés et al. (2019); Montes-Iturrizaga and Arias (2022); Rodelo et al. (2021); Mirabal et al. (2020); Pérez et al. (2020).	Formative and investigative vision	Hidalgo (2022); Beltrán et al. (2021); Colas and Hernández de la Rosa (2021); Turpo et al. (2020); Escobar (2020); Salas-Ruiz (2020); Rivas-Díaz (2020); Flórez et al. (2018); Pardo-Rozo (2022); Ponce et al. (2021).	Curriculum policy
Alonso (2021); Velandia-Mesa (2020); Molina et al. (2019); Álvarez et al. (2022); Chuico et al. (2021).	Research vision	Juarez and Torres (2022); García et al. (2018).	Formative vision
Cortina et al. (2022).	Favorable attitudes for research	Esteban et al. (2021).	Quality management

Note. Perceptions in the present study have been considered as an idea, belief or opinion that is limited to the simple knowledge of formative research.

However, in most of the existing works to date, there is a prevailing lack of clarity in the processes of approaching the FI in order to enhance research knowledge (competence). General or partial strategies such as information gathering, research seminar, monographs, projects, among other academic documents are used; being aware that these products are useful means to demonstrate the level of development of research skills, however, this would not be sufficient for a comprehensive approach to the curricular-investigative-formative dimensions. In this context, ten (10) analyzed proposals are presented with their respective contributions (see table 6).

Table 6. Formative research proposals

Quote	Contribution	Quote	Contribution
Campos et al. (2022)	In a pre-experimental study, with a sample of 102 participants, the benefits of formative research in five stages: sensitization, adoption, interaction, valuation and confrontation (SAIVC) were categorically affirmed. The strengthening of the inquiry competence in students of the education career was accomplished through the developed program. It is a contribution that contributes to the improvement of quality in universities, spreading the methodology to other professional careers. Finally, it guarantees scientific production as a genuine practice; with benefits not only for the academic environment.	Pardo-Rozo (2022)	They put forward a proposal for awareness activities for students. Among others, they suggest incorporating applied research in course units, the promotion and participation in research groups and research seedbeds, an increase of academic credits in the curriculum and the rethinking of the research lines of the study program.
Formative Research to Strengthen Enquiry Competence in University Students		Towards research training in the business administration program at the Universidad de la Amazonia (2021-2028), Caquetá - Colombia.	
Juarez and Torres (2022)	They suggest, in the context of action research, to implement a didactic strategy of FI that includes: the correction of contents that derive in specific projects for each reality, that try the formal processes of research; starting from the identification of the problem, formulation of questions, strategic search of information articulated to the purposes, knowing how to evaluate-select the contents and produce new ones from the findings; that is, alternatives of solution to real problems identified by the students themselves.	Álvarez et al. (2022)	They propose the development of research skills integrated with intellectual skills to achieve an investigative work. This implies considering the following stages: 1Modeling: Exploring the reality; setting out the purposes; locating the indicators and dimensions of the study; forecasting the actions and their effects. 2Obtain: Attributing signs to the classified, evaluated, organized and selected information. 3Process: Involves analysis, organization, identification of key ideas; reworking of information, as well as comparison of results. 4Communicate: Referring to the analysis of information, ordering it, elaborating it. However, it is important to classify which is the variant of its communicative form according to the case. 5Control: Pay attention to the findings; demand the comparison of conclusions and results; determine those fundamental terminations; give feedback about the process and the consequences of the action. These five processes are aligned to the intellectual skills to be applied at any time; summarizing, examining the contents multilaterally, relying on various contributions of science, judging-valuing, starting from objective pre-suppositions, using argumentation, comparing, among others.
Basic investigative competence. A didactic strategy for the digital era		The formation of research skills in high school students. Insutec case	

Quote	Contribution	Quote	Contribution
Rodriguez-Vargas et al. (2020).	It is a quasi-experimental study (8 students in each group evaluated) that determined the effectiveness of the formation of "researcher's seedbed" research groups in universities, which strengthens the formative research processes in university students.	Velandia-Mesa (2020)	They contribute with the proposal of a scale to evaluate educational research training. It contains nine research competencies (ethical, technological, argumentative, relational, communicative, critical, propositional, methodological and analytical) combined in 27 evaluative discernments and finally conceptualized in 10 learning outcomes embodied in the assessment scale. It is an instrument based on mathematical modeling around the answers to the question and adapted to the Guttman scalogram.
Researchers' seedbeds for the development of research competencies in the universities		Evaluation of educational research training: design and validation of scales.	
Ponce et al. (2021)	They present a strategy at the curricular level, considering in the formative project, the graduate and professional profiles of the university students. The strategy has three stages within a systemic conception of the formation process of research competencies where the Student-Researcher category is assumed to be valid. First stage: <i>Theoretical and methodological bases of professional research</i> (where they must first learn the methodologies of research and second, receive guided workshops for the management of integrative projects and linkage with their profession). Second stage: <i>Improvement of competencies in the management of formative research projects</i> (action one is the structuring of pre-graduate projects; two, development of the pre-projects following a theoretical and methodological design; three, moment of the presentation of the elaborated pre-project). Third stage: <i>Development of undergraduate research</i> (it is necessary first to support the research idea and its profile. Then, the work directed by a tutor and finally the presentation of the degree work).	Alfaro-Mendives and Estrada-Cuzcano (2019).	They demonstrated in a pre-experimental work with thirty-two subjects, that the research seedbed proposal in the classroom process has evident results in research skills: language mastery; conducting cognitive operations, knowing how to observe and debate; social construction of knowledge; and, reconstruction of such unknown discernment.
Training of professionals based on research projects.		"Semilleros en aula" in the development of research skills of library science students at the Universidad Nacional Mayor de San Marcos.	
Flórez et al. (2018)	They presented a didactic proposal to implement Formative Research, Dicriarte (Di: teacher-student relationship in the classroom; Cri: Referred to the critical thinking that should be fostered from the teacher to the student and from the student to the whole environment, in the classroom formative process; Art: thought as a protagonist tool in the development of this didactic, from autochthonous expressions of the students. It seeks the real and deep integration of knowledge, transforming their mentality by creating academic processes in systemic networks that accompany the student's educational process from the beginning of their professional career.	Garcia et al. (2018).	From the quasi-experimental work carried out with 140 university students, we conclude the effectiveness of working on communicative skills (speaking-listening-reading-writing) and investigative skills (observing-describing-analyzing-synthesizing-interpreting), a stimulus that should be replicated in a progressive didactic oriented to develop formative research.
Formative research: Elements and proposal for a didactics of the classroom; beyond a trend.		Formative research in the development of communication and research skills.	

Note: The proposals selected correspond to the totality of those found. It is considered important to present them in order to contribute to the systematization of advances in the subject.

Finally, after the presentation based on the purpose of the study and the integration of the findings, Figure 1 is presented, which reflects a clear picture of FI as a strategy. Among other reflections, the semantic relationships attempt to answer the following questions: where should FI originate, what semantic relationships with elements and actors exist, how is it conceived, what is the scenario for developing it, who would be the beneficiaries, and what is the level of impact that would be achieved as a result of these processes in university education? Along these lines, the strategy can be described as actions based on a research culture that dynamizes the curricular policy in universities, in relation to sustaining a formative, investigative and formative-research vision for the students of different study programs through the improvement of undergraduate curricula, in order to train researchers and contribute to the production of scientific knowledge; moreover, to favor the preparation of professionals with high critical capacity to develop themselves in all areas of life.

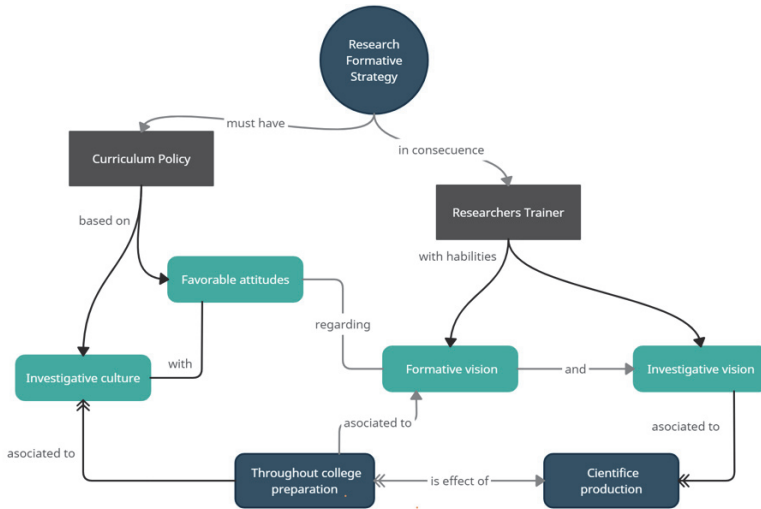


Figure 1. Conceptual relationships and emerging insights in the study.

4. Discussion

In the present study, articles from the period 2018-2022, which deal with formative research at the university level-undergraduate, were examined from the interdisciplinary approach. In this perspective, the highlighted definitions, perceptions and sustainable proposals that foster inquiry skills in students are sequentially interpreted. All these sub-categories provide a clear and accurate picture of the problem investigated, a scenario that enables new scholars to develop research that will certainly solve theoretical and practical problems in this area, rooted in the university stage.

With respect to the definitions found of the variable under analysis in 43 articles of the 84 pre-selected, three can be highlighted. One, the study by Campos et al. (2022), who argue that FI prepares students to solve problems in their environment from a more technical and rigorous perspective using the scientific method. Two, Ramos et al. (2022) state that there are two aspects to be developed, on the one hand, disciplinary knowledge and, on the other, an increase in scientific production. Three, Hidalgo (2022), finds very important the curricular organization of universities, where FI is knowledge and a useful strategy for learning to learn based on research skills, especially the cultivation of critical reasoning. Undoubtedly, the aforementioned concepts are complementary to each other under the required vision of today's society and education in the international university system.

The above makes it easy to understand the potential of formative research in the development of the research component, this being the main and mandatory function of universities, but also a challenge as stated by Colas and Hernández de la Rosa (2021), in view of being a strategy that is not widespread, in the process of becoming a transversal axis of the curriculum for the training of professionals (Rivas-Díaz, 2020). Incidentally, Esteban et al. (2021) intervenes to clarify the differences between FI and research training, highlighting that the former, with a more pedagogical connotation, does not ensure the scientific production that quality systems recently consider as an evaluation indicator. However, the research culture alluded to by Alvarez et al. (2021); Arenas et al. (2020); Espinoza (2020); Ponce et al. (2021) and Barrios et al. (2019), would increase the benefits of formative research in university students, not only because it trains researchers through their research groups and is a transversal didactic strategy, but also because the mechanism ensures favorable attitudes to research, destroying the myth that *only scientists do research*. In addition, its

multidisciplinary value makes its application to any field of study and profession varied and productive, as evidenced in the works of Cortina et al. (2022) and Ramos et al. (2020); Almonacid and Fernández-Maroto (2022); Castro-Rodríguez (2021); Escalada and Pérez (2021) and Alonso et al. (2021); Esparza-Reyes and Morales-Trapp (2021); Salas-Ruiz (2020), Arenas et al. (2020) and Zúñiga and Duarte (2019); Molina et al. (2019); Cortés et al. (2019); Pardo-Rozo et al. (2022); Montes-Iturrizaga, and Arias (2022) and Campos-Ugaz et al. (2022). The authors studied FI experiences in nursing, architecture, dentistry, medicine, law, engineering, accounting, journalism and communication, business administration, and education, respectively.

It is worth reflecting on the inclusive nature of FI, where all the actors in the training process can acquire the skills for inquiry, starting from forging themselves throughout the semesters of study, if it is considered in theory and in praxis, a guideline for curricular planning. In other words, FI requires a strategic organization of competence for the learning-teaching process, where the teacher remains a guide and the student assumes the role of researcher, a characteristic to be contemplated in his or her graduate profile. An emerging idea in this regard is the systemic nature of the FI that orders the process of curriculum management in universities. This involves the tool as such, the curriculum (planning) as the bridge between pedagogy (theoretical vision) and didactics (practical execution). Moreover, it considers fundamental the performance of the student who becomes the protagonist of his learning, in accordance with the expressions of Campos (2020), when he emphasizes that it is a strategy in and for university classrooms.

Thus, it can be said that FI is a transversal strategy that fosters the development of inquiry competence. Aligned to the pedagogical practice, it has to be considered as any educational process that is planned, executed and evaluated; a step by step related to the systemic sequence that involves the development of basic skills (reproductive level) in undergraduate, intermediate skills (productive level) and advanced skills (creative level) at postgraduate level; master and doctorate, as appropriate. So, how to move forward without planning? If guidelines for curricular management are not considered, it is not possible to promote it because there is no planning at the level of the university curriculum that organizes the products and all the subjects with a research orientation. Moreover, students from the first cycle of studies lack opportunities to develop research skills, they are limited to the development of some products, at first monographs and essays, until almost the end of the career in which they develop a thesis project and the final report.

Ideally, it is a matter of fostering skills to form researchers who can transcend with scientific production and dissemination. This would be possible if we consider the levels of knowledge with which, from categorical, critical and creative thinking of young people before the age of seventeen, they evolve to the scientific thinking of the university age and stage. Under this vision and for the purpose of continuous improvement, curricular management could contemplate that students from the first cycle can strengthen inquiry competences and produce, approximately from mid-career, theoretical, systematic and bibliometric review articles, based on a sustained research activity.

Regarding perceptions, trends can be categorized that position FI as a model, where the set of strategies at the level of curricular and didactic management consolidate the training of researchers. Four stand out, firstly, curricular policy by the authors Hidalgo (2022); Beltrán et al. (2021); Turpo et al. (2020); Colas and Hernández de la Rosa (2021); Escobar (2020); Salas-Ruiz (2020); Rivas-Díaz (2020); Flórez et al. (2018); Pardo-Rozo (2022) and Ponce et al. (2021). The works reflect the concern of higher education institutions to respond to continuous improvement and educational quality controls, considering the strategy with great potential for development, but which has not yet materialized, probably due to the magnitude of the changes that even mean migrating to educational models more in line with the technological era and demands of the globalized world. As Valero (2021) expresses, it is a challenge for academic programs to modify the university curriculum and include FI as an essential strategy. Hence, it would be the combination of research methods with the teaching-learning process, and scientific production among university students and their teachers should characterize education at this level of studies.

Secondly, the formative and research vision, argued by Ramos et al. (2022); Castro-Rodríguez (2021); Cortés et al. (2019); Montes-Iturrizaga and Arias (2022); Rodelo et al. (2021); Mirabal et al. (2020); Pérez et al. (2020). This perception is in agreement with the position of Sabariego et al. (2020), who believes it is important to confirm the close relationship between the development of research skills and the initial training of professionals in education, promoting autonomy, information search and management of research projects to address identified problems. In her experience, she considered three transversal competencies, critical thinking-teamwork-transfer and communication of knowledge. Undoubtedly, training and research, although they can be defended in a dissociated way, both become a functional unit that curricula should generalize, asserting forcefully that FI is a strategy par excellence, useful for the field of professional development and practice as well as for scientific production.

A third perception with several coincidences among the authors is research culture: Álvarez et al. (2021); Arenas et al. (2020); Espinoza (2020); Ponce et al. (2021); Barrios et al. (2019). Also, researcher trainer in the works of Campos et al. (2022); Zúñiga and Duarte (2019); Patiño et al. (2018); García et al. (2018) and Castro-Rodríguez (2022). Reflections on the process of acquiring research skills throughout university studies, including undergraduate and graduate studies, are worthwhile. This is a context in which, according to conceptual pedagogy, the student should be valued by the cognitive aspect, but also the affective one (de Zubiría Ragó and de Zubiría Samper, 2019). With the first, it is intended that all students deploy their basic intellectual operations, starting from the reproductive level (forged at the undergraduate level), productive (ideal in master's degree students) and creative (yearning in the process of obtaining the doctoral degree), so that this intellectual machinery energizes the spaces of their life at the university, at work and in the different daily ways of interacting of human beings. Finally, with the affective conceptual pedagogy, oriented to the formation of self-realized and happy people, the prototype of professionals who carry out research as part of the natural processes of their formation, the development of their field of action, would be molded. With the above, it can be affirmed that the FI would contribute to the resolution of problematic situations with positive attitudes on the part of university students, raising the levels of personal satisfaction, having discovered that research skills can be part of their culture and does not limit the people who wish to enhance them.

In relation to papers with contributions, the works of Campos et al. (2022); Rodríguez-Vargas et al. (2020); Pardo-Rozo (2022); Juárez and Torres (2022); Álvarez et al. (2022); Velandia-Mesa (2020); Ponce et al. (2021); Flórez et al. (2018); Alfaro-Mendives and Estrada-Cuzcano (2019), García et al. (2018) were analyzed. Of the ten contributions originated in research processes, four stand out for presenting methodologies at an experimental level that prove the viability of the contributions and generalization of the results. Before, it is important to mention the coincidences between the proposals, which support concepts and perceptions of the findings and lead to theorize that, it is a didactic, methodological, curricular strategy, with transversal and systemic character applied in an interdisciplinary way, in favor of the integral formation as the production of knowledge, therefore, the transformation of societies. However, it is still in the initial processes to be assumed, probably due to low levels of involvement by teachers of a previous generation or causes centered on the conventional educational system.

Among the studies with proposals on FI, we have Campos et al. (2022). They developed awareness, adoption, interaction, valuation and confrontation (SAIVC), a program within the framework of thesis subjects in the education career of a Peruvian university with highly significant results; Rodríguez-Vargas et al. (2020), Alfaro-Mendives and Estrada-Cuzcano (2019) form research groups, called *semilleros*; and, García et al. (2018) increase research productivity by developing communicative and investigative skills in students. In coherence with the above, it becomes a key alternative that enhances scientific capabilities (problematization, theorization, verification of reality and communication of results), aspects that should be integrated transversally in university classrooms, whose purpose is to achieve competent professionals, also in the research field and impact on the efficient resolution of problems related to their environment.

5. Limitations

Finally, some limitations were identified in the systematic literature review, such as finding the general approach to the category studied, still lacking clear definitions, which distracts the extraction of perceptions. There is also an incipient number of proposals if one takes into account only the experiments carried out in which the effectiveness of the strategies is demonstrated. In this context, it is recommended to the academic community to carry out basic and applied research, contributing to the development of scientific knowledge, solving, by the way, theoretical and practical problems that afflict university education, whatever the professional field, specifically in the research component.

6. Conclusions

Formative research is a transversal strategy that promotes the development of inquiry competence. Aligned to pedagogical practice, it should be considered as an educational process that is planned, executed and evaluated; a step-by-step process related to the systemic sequence that involves the development of basic skills (reproductive level) at undergraduate level, intermediate skills (productive level) and advanced skills (creative level) at postgraduate level; master's and doctorate, as appropriate.

Ideally, the idea is to foster skills to train researchers who can transcend with scientific production and dissemination. This would be possible if we consider the levels of knowledge with which, from categorical, critical and creative thinking of young people before the age of seventeen, they evolve to the scientific thinking proper to their age and university stage. Under this vision and for the purpose of continuous improvement, curricular management could contemplate that students from the first cycle can strengthen research skills and produce, approximately from mid-career, theoretical, systematic and bibliometric review articles, based on a sustained research activity.

Finally, an emerging idea when analyzing concepts, perceptions and contributions on FI, is the systemic, inclusive and interdisciplinary character that orders the process of curriculum management in universities. This involves all the actors in the houses of study and the tool as such, the curriculum (planning); the bridge between pedagogy (theoretical vision) and didactics (practical execution). Undoubtedly, the mechanism unifies the criteria for acting in any of the formative disciplinary fields, with the ultimate goal of permanently contributing to the development of knowledge and scientific production.

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