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Review article

Formative research for teaching and learning in universities

Investigación formativa para la enseñanza y aprendizaje en las universidades

Pesquisa formativa para ensinar e aprender nas universidades

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ABSTRACT
Formative research has acquired vital importance in the curricular plans of universities, since it can be seen as a strategy to train students in research. The purpose of this review article was to describe the concept of formative research and its implementation in higher education. For the location of bibliographic documents, different academic databases and search engines, journal portals and electronic books were used; then, we proceeded to select the articles that prioritized the theoretical foundations of formative research, investigative training and formative research, characteristics of formative research, research as a pedagogical strategy and model of formative research in universities. To begin with the elaboration of the review article, a documentary analysis, group discussion and evaluation of the quality of the articles found were carried out. It was concluded that formative research is a teaching strategy in higher education centers, in which teachers and students participate during the curricular development of a professional career and allows teaching scientific research skills.

Keywords: curriculum; teaching strategies; research training; formative research.

RESUMEN
La investigación formativa ha adquirido vital importancia en los planes curriculares de las universidades, ya que puede ser vista como una estrategia para formar a los estudiantes en investigación. El presente artículo de revisión tuvo por finalidad describir el concepto de investigación formativa y su implementación en la Educación Superior. Para la localización de documentos bibliográficos se utilizaron distintas bases de datos y motores de búsqueda académicos, portales de revistas y libros electrónicos; después, se procedió a seleccionar los artículos que priorizaban los fundamentos teóricos de la investigación formativa,

formación investigativa e investigación formativa, características de la investigación formativa, la investigación como estrategia pedagógica y modelo de investigación formativa en las universidades. Para comenzar con la elaboración del artículo de revisión se procedió al análisis documental, la discusión grupal y la evaluación de la calidad de los artículos hallados. Se llegó a la conclusión de que la investigación formativa es una estrategia de enseñanza en los centros de Educación Superior, en la que participan docentes y estudiantes durante el desarrollo curricular de una carrera profesional y permite enseñar habilidades de la investigación científica.

Palabras clave: currículo; estrategias de enseñanza; formación investigativa; investigación formativa.

RESUMO
A pesquisa formativa adquiriu importância vital nos planos curriculares das universidades, pois pode ser vista como uma estratégia para formar estudantes em pesquisa. Este artigo de revisão teve como objetivo descrever o conceito de pesquisa formativa e sua implementação no Ensino Superior. Para a localização dos documentos bibliográficos foram utilizadas diferentes bases de dados e buscadores acadêmicos, portais de periódicos e livros eletrônicos; Em seguida, foram selecionados os artigos que priorizaram os fundamentos teóricos da pesquisa formativa, formação investigativa e pesquisa formativa, características da pesquisa formativa, pesquisa como estratégia pedagógica e modelo de pesquisa formativa nas universidades. Para iniciar a elaboração do artigo de revisão, procedeu-se à análise documental, à discussão em grupo e à avaliação da qualidade dos artigos encontrados. Concluiu-se que a investigação formativa é uma estratégia de ensino nos centros de ensino superior, em que docentes e discentes participam durante o desenvolvimento curricular de uma carreira profissional e permite ensinar competências de investigação científica.

Palavras-chave: currículo; estratégias de ensino; formação investigativa; pesquisa formativa.

INTRODUCTION

Research is an organized and objective process, whose purpose is to obtain, through observation and experimentation, new knowledge that is needed to expand the various fields of science and technology, in order to obtain clear and precise results; it is closely linked to human beings and has a series of steps to achieve the stated objective or to reach the requested information. Research has as its basis the scientific method, which is systematic and includes observation techniques, rules for reasoning and prediction, ideas about planned experimentation and ways of communicating experimental and theoretical results (Hidalgo and Pérez, 2015). In addition, it is an essential function in the university, which is why it is important that universities develop research skills in their students and teachers, through the necessary, integral and non-mandatory incorporation of research as a differentiating element of learning within the curriculum and the institution.

For their part, Valencia and Ferrer (2013) state that "the academic and formative capacity of the university is a function of its scientific capacity, that is, in terms of its ability to build new knowledge. From this perspective the university develops both criteria, both basic scientific research as such or applied or technological research that are producers of knowledge and formative research associated with the teaching-learning strategy" (p. 24).

According to Guerra (2017), there are two elements that must be taken into account in universities to develop their research function. On the one hand, training for research; and on the other, formative research. On the other hand, it mentions the scope of formative research hand in hand with research training as a tool not only for the apprehension of knowledge, but also as a set of practices that allow the student to develop and generate a research competence. In this way, universities will train researchers that the country requires to develop new knowledge and not just be mere consumers of information.

In addition to instruments and methods, research is needed to create a "culture" and inculcate positive attitudes among students and teachers, giving them the opportunity to think meditatively about their reality. Therefore, the inclusion of research in the different academic processes in Higher Education is unavoidable. Research training not only covers research training, but also training for research. It is about students not only learning, understanding and applying a method, but also learning to research, researching, to prevent the method, in our case, of research, from being taken only as a curricular content (Ramírez-Marroquín, 2015; Hernández-Royett *et al.,* 2018).

In this sense, the objective of this bibliographic, documentary and descriptive review study was to describe the concept of formative research and its implementation in Higher Education, in which its characteristics are identified and analyzed from different points of view, such as: theoretical foundations of formative research, investigative training and formative research, characteristics of formative research, research as a pedagogical strategy and model of formative research in universities. The following activities were carried out: definition of the search criteria; exploration and selection of documents according to the established criteria; selection and systematization of the information; analysis of the information according to the identified categories; generalization and comparison of the analysis with another related research. The search for documents was carried out in various databases, such as: Scielo, Dialnet, Scopus, Sciencie Direct, RedALyC, Mendive, Scopus, ProQuest and Google Scholar. The criterion for choosing these databases is based on the high impact factor they have achieved in the different indexing systems. Once the documents were chosen, the different analyses were elaborated in a descriptive manner based on the categories listed.

DEVELOPMENT

Theoretical foundations of formative research

The concept of formative research has been addressed by different authors, who have agreed on some aspects of its definition. Formative research is framed within the pedagogical current of constructivism, from which it stimulates learning, encourages reflection on the process and the research culture, understood as the generation of an adequate space for teaching and research practice, as well as the norms, values and attitudes associated with it (López-Espitia, 2017). Authors such as Guillermo-Jiménez (2006) define formative research as a means of integrating curriculum and pedagogical practice with research, through a variety of possible strategies in a classroom. Parra (2004) believes that, if formative research is worked transversally across the curriculum, it can significantly improve pedagogical and didactic processes, since it helps to reinforce them through the implementation of the scientific method in the resolution of specific problems.

Other authors such as Espinoza, Rivera and Tinoco (2016) speak of formative research as a way to train in research through the participation of students in projects that manage to familiarize them with the scientific method. In this sense, authors such as Rubio-Hurtado, Vila-Baños and Berlanga-Silvente (2015) think that students should be the protagonist of their training process, and that curricula should contain, in addition to the specific competencies of the academic program, competencies that aim at strengthening their research capacity.

On the other hand, the concept of formative research has three meanings. One is exploratory research, whose purpose is to carry out a search for articles, documents, completed research, which propose notable and important problematic situations and whose findings serve as input to other research of greater scope. The second is related to training in and for research; in this sense, the work involved is to grasp the logic and functioning of scientific research. The different educational strategies and activities carried out in university subjects give life to these concepts of formative research. Finally, the third meaning refers to action-research or transformation in action or practice; that is, to that research conducted in specific situations to improve a program (Restrepo, 2007; Lizarzaburu *et al.,* 2019).

Also, formative research refers to a set of learning strategies of inquiry, exploration of reality and construction of knowledge; it is focused on action or practice that seeks not only a real approach to research, but is conducted under strict scientific standards, suggesting the participation of students in already consolidated research groups. The most important thing to understand about conducting formative research in the educational context is that it is not unidirectional, but provides very important skills in the cognitive development of students, such as the use of appropriate language to promote communication, critical thinking and the estimation of judgments about processes, decisions and attitudes (Restrepo, 2003). In this sense, teachers are the experts in research and students are the researchers in training. The specific function of formative research is to create a culture that promotes autonomy in thinking, rational criticism, interdisciplinary and collaborative work. Unlike rigorous research, this type seeks to teach research in the field of educational practices; research in the strict sense is concerned with the creation of new knowledge. Formative research can be defined as teaching through research (Parra, 2004; Rojas and Viaña, 2017).

The review by Rojas and Aguirre (2015) presents the debates on aspects of formative research (curricular processes and research training strategies, process executors, institutional conditions at the macro and micro levels), which contributes to the understanding of the field and formulates questions to continue in this task. In addition, it also provides an account of essential concepts associated with formative research, which revolve around: research competencies (linked to the axis of know-how, understood as suitability, organized behavior, performance, interaction, know-how and know-how to be), research skills, research attitudes and research capabilities. The trends are centered on the concept of research training, seen as a mediation process that seeks to transform people's capacities for the appropriation of knowledge or to develop competencies.

ollowing Hernández (2003), the name formative research is used to refer to the processes of acquisition, construction and reconstruction of knowledge inside and outside the classroom, which have procedural analogies with research in the strict sense, but which do not produce knowledge admitted as new and valid by international academic communities. This refers to the hard and exact sciences such as physics, chemistry, medicine, etc., which are based on paradigms of global laws, which means that formative research is taken more

as a didactic and educational proposal for research training than as a research method. He also speaks of the importance of intensifying the links between research and teaching and makes the difference between pedagogical research and formative research; therefore, he questions the possibility of a quality professional training without research, and points to this as a condition that defines the identity of the university and recognizes its crucial importance in the relations between university and society.

It can also be pointed out that formative research is an educational process for acquiring competencies related to the analysis of information, research methodology, the formation of critical judgments and, in general, the structure of a research process within the curricular framework established by the university. Unlike research itself, which seeks the generation of new knowledge, formative research aims to train students to have the ability to propose, design and implement a research project in their future area of work performance (Hidalgo and Perez, 2015).

Another definition of formative research is given by Miyahira (2009), Montoya and Peláez (2013) when they define it as a method of the teaching-learning process used by teachers in charge of trainees, who acquire knowledge that will be validated later in their professional life. Restrepo (2003) mentions the importance of the relationship between teaching and research, as it represents a pedagogical and didactic problem that addresses the role of the latter in the learning process. Along the same lines, Silva, Torres, González and Sarmiento (2008) mention some ways of integrating teaching and research, such as the inclusion of subjects related to research in the curricula, the establishment of links between teachers and students through extracurricular projects and spaces and, finally, the enhancement of research competencies through research workshops.

Hidalgo and Pérez (2015) state that in order for formative research to be conducted in universities, three conditions must be met: the formation of research competencies carried out and directed by a professor, the researchers in training will be students, and it must be inscribed within the curriculum. The most important thing to understand about conducting formative research in the educational context is that it is not unidirectional, but provides very important skills in the cognitive development of students, such as the use of appropriate language to promote communication, critical thinking and the estimation of judgments about processes, decisions and attitudes.

Other authors such as Landazábal, Pineda, Páez and Téllez (2010) contribute their ideas regarding formative research and see it as "a set of practices that allow the development of research skills, referring to a set of skills, of diverse nature, that can become the central axis of research training" (p.139). Roncacio and Espinosa (2010) state that formative research "means learning to research by researching, learning from doing in the concrete, where it is possible to explore needs in real contexts of society and transfer the knowledge learned" (p. 155).

Investigative training and formative research

Guillermo-Jiménez (2006) distinguishes between research in the strict sense and formative research, clarifying that in the former, formal projects with defined lines are developed within research groups in which teachers generally participate as principal investigators and with the objective of generating new knowledge in a specific discipline. In addition, Montoya and Peláez (2013) and Hidalgo and Pérez (2015) highlight the difference and relationship between formative research and research, in the strict sense.

According to Hernández (2003), scientific research is particularly demanding and its forms of recognition and evaluation are very different from the local evaluation to which what has been called formative research is subjected. The differentiation between the universal and the local can help us to clarify the differences between formative research and research. So-called formative research is so called because in its knowledge construction procedure it follows the steps of research. However, its academic meaning and the novelty of its results are important at the local level and do not need to be validated by an international academic community. Reviewers of formative research do not subject the processes and results to the rigorous judgment of an ever-widening group of experts. In formative research, participants learn to consciously experience the pleasure of knowing more; this pleasure is sufficient reward for the effort.

Restrepo (2003) mentions that the practice of research is manifested in two ways: teaching research and doing research. The first alludes to the exercise of investigative teaching; that is, to using research in teaching, both to give it scientific relevance and to familiarize students with the logic of research and initiate them in its practice, that is, to advance in investigative training. The second refers to the systematic production or generation of knowledge and its application to solve problems of the context. Research training focuses on providing a basis for the understanding and management of fundamental methodological processes and formative research is aimed at promoting a research culture and the training of researchers.

Furthermore, Restrepo (2008), speaking of training for research, asserts that formative research is a process where the student learns to research by researching, the content is not privileged but the form, since scientific research creates knowledge and formative research appropriates it to contextualize and transform it, given that the student receives it as a pedagogical problem. Citing new meanings, we find the definition of Parra (2004) in this regard, which indicates, "formative research as that research that is part of the teaching function with a pedagogical purpose and that is developed within the formally established curricular framework" (pp. 72-73).

The debate on the relationship between teaching and research, and on the relationship between research training and the research mission of universities, strictly speaking requires the strength of formative research and scientific research. The first is fundamental at the undergraduate level and the other corresponds to the master's and doctoral levels. However, both types of research, formative and research in the strict sense, are aimed at raising awareness and promoting research culture. Formative research, according to experts, serves to train the agents on which society needs to work in order to generate knowledge and its various applications. Formative research establishes environments for practices and serves as a laboratory, where teachers and students become familiar with the use of research methods and techniques in order to subsequently form research groups in the strict sense of the term. Without quality and diverse formative research today, it is unlikely that research in the strict sense will be successful tomorrow (Restrepo, 2007).

Characteristics of formative research

Formative research has two basic characteristics. One is that the research is led by the teacher, as part of the teaching function, and the researchers are the students in training, rather than an expert researcher (Robalino, 2017). In such sense, Rojas and Viaña (2017) argue that to train in research it is necessary to promote a space where research skills are developed and improved because these advances will affect the knowledge, existence and behavior of future professionals. This demonstrates in

the promotion of these skills how critical thinking, autonomy, analysis, collaboration and interdisciplinary research will direct new teachers to learn to see, analyze, interpret, understand and act reflexively in the different situations that arise.

Similarly, formative inquiry requires university faculty to adopt different positions on educational subjects and students. The first is to emphasize the complex, dynamic, and evolving nature of knowledge, and the second is to recognize and accept their student's latent responsibility to play a leadership role in learning. Formative research and research training must evolve in constant interaction. Formative inquiry develops students' abilities to interpret, analyze, and synthesize information to find open-ended problems, critical thinking, and other skills such as observation, explanation, and comparison. All of these are also directly related to research training (Torres, 2018).

According to Parra (2004, p. 73), Restrepo (2007) and Espinoza (2020), formative research has the following characteristics:

- It is not oriented to the generation of objectively new knowledge, but to the comprehensive (or meaningful) appropriation of already elaborated knowledge.
- It has a curricular intention, in the sense of being a path for the development of teaching-learning processes, linked to predetermined objects of knowledge.
- It is not properly framed within a line of research, but within a formative academic program.
- Its relevance is given by the curricular objectives or training purposes of the academic program within which the formative research is developed.
- The object of research belongs to an already established area of knowledge.
- The methodological dimension (research techniques and instruments) is subordinated to its didactic purpose, in coherence with the object of study.
- It is research directed and guided by a professor, as part of his or her teaching function.
- Research agents are not research professionals, but subjects in training.
- The achievement of skills and abilities linked to formative research in the classroom promotes the integral development of the university student for the acquisition of professional competencies with bases.
- Every classroom teacher should be trained to conduct formative research as a didactic strategy for the achievement of curricular objectives.
- Formative research produces local knowledge, subjectively new, oriented to professional know-how.
- The student learns to investigate, while acquiring knowledge, skills and values.
- Development of the student's capacity for cognitive independence.
- Promotes collaborative and cooperative spaces for meaningful learning.
- Contribute to the solution of pedagogical problems.
- They promote the use of productive methods.

Formative research, due to its binding nature with the teaching-learning process, has some implicit limitations, namely (Espinoza, 2020, Sanchez, 2017):

- They are limited to exploratory or probing types of research, which will allow students to later define their research objectives using the theoretical and methodological knowledge already learned.
- The procedures, methods and techniques used do not have the rigor

of a scientific research; biases may arise as a consequence of the student's own learning dynamics, which is realized in the execution of the research process itself.

- They are carried out through curricular work, which means that the execution times are short, under a programming by the teacher that allows obtaining results for the final report of the research.

The curricula of each university professional career must take into account a line of research in the organization of the curriculum (Sánchez, 2017). According to Espinoza (2020), formative research aims to provide students with the possibility of assuming favorable attitudes towards research processes; they are considered teaching-learning strategies based on productive methods and meaningful learning by discovery; they are not exclusive to the university environment, they can be used in the other teaching subsystems.

Research as a pedagogical strategy

According to pedagogy and didactics, it is necessary to approach formative research from teaching strategies. There are two teaching strategies: the first is the expository or reception strategy, more focused on the teacher and the content, where the presentation, discussion and exercise, recapitulation, evaluation and conclusions are the teacher's responsibility. The second strategy is learning by discovery and construction of knowledge, more focused on the student, where the teacher poses unfinished or not completely structured problems, leaving them to be completed or structured by the students, activating their cognitive processes such as: searching, inquiring, reviewing similar situations, collecting data, organizing, interpreting and proposing solutions, constructing knowledge or learning, regardless of whether it exists. In this strategy there are two possibilities: first, incomplete problems where the student must do everything, and second, the teacher structures and poses the problem from the beginning to the students (Restrepo, 2003, 2004).

Formative research positions the student as the active protagonist of his or her own learning process. The role of teachers is to accompany and support students towards independent learning, motivating them to work autonomously. The student takes an active role, works in a team, seeks information and plans the work, makes his or her own decisions, integrates knowledge and develops diverse competencies. When students are involved in a dynamic and interactive process, it can be concluded that encouraging learning through projects has a positive effect in fostering research (Ruano-Ibarra, 2017).

According to García, Paca, Arista, Bonifaz and Gómez (2018) formative research has a positive impact on the development of communicative (listening, speaking, reading and writing) and investigative (observing, describing, analyzing, synthesizing and interpreting) skills. It is thus demonstrated that, with the use of strategies such as: information gathering, research seminar and monograph, together with the profile of a teacher promoter who manages the research methodology and incorporates it in his pedagogical practice, leads to the development of research and communication skills in university students. These results show that formative research must become a permanent and gradual activity in university education in order to be effective.

According to Parra (2004), formative research, considered as a pedagogical strategy for curriculum development, integrates three elements: didactic techniques, teaching style and specific training purpose. It will be research to the extent that it preserves the logical and methodological structure of research

processes, and it will be formative if its function is to contribute to the purpose of teaching.

- Didactic techniques: it consists of the requirement to contextualize the object of teaching for its integration into the student's cognitive structure, which implies using techniques and instruments of observation in a systematic way, to favor the acquisition by direct experience of the object of study.
- Teaching style: it emphasizes the participation of the university teacher in a defined position before the object of teaching and the students, standing out for the dynamic and progressive nature of the knowledge exposed, its complexity and contingency, emphasizing the possibility of reason to understand reality.
- Specific training purpose: refers to the orientation of the formative research towards helping the student in the acquisition of a range of competences, skills and attitudes for the qualified exercise of a professional activity.

It is important that professors take into account the competencies that their students are able to acquire and, in addition, are able to decide on the use of appropriate methodologies to train them in research. Universities should be considered a center of knowledge creation that promises to establish research cultures that connect knowledge with real-life situations. According to Parra (2004), Restrepo (2003) and Espinoza (2020), formative research can be integrated in the development of all subjects of a curriculum, in a progressive way, in depth and extension. Some formative research techniques that can be permanently incorporated into university teaching, almost in any area, are:

- Theoretical essays, with research outlines (defined topics, hypothesis, methods, variables, results, discussion and argumentation, conclusions). The fundamental characteristic of the essay, generally brief, is to reflect the author's position on the subject, as a starting point for a deeper academic discussion.
- Discovery learning strategy (research seminar). Through this, the undergraduate student acquires knowledge and skills on problem formulation, information management, through the use of Information and Communication Technologies (ICT), related to the state of the art and construction of the theoretical frame of reference.
- The journal clubs. It consists of tracking, reviewing and categorizing the literature related to a given topic of study. This technique is fundamental to achieve a panoramic vision of a certain area of knowledge; it constitutes a rigorous initial exploration of the approaches, trends and problems present in an object of study.
- Seminars or investigative pre-seminars, which favor learning by discovery and argumentative discussion. These require that the topic of study be approached from multiple perspectives, which are related and contrasted with each other. They must be supported by documentary studies, and therefore require a basic level of bibliographic management. They allow a broad and integrated vision of the objects of study and identify the controversial nuclei of an area of knowledge.
- Research Seminars. It is a teaching strategy that approaches knowledge from the perspective of active and constructive teaching. The seedbeds foster independent, team and directed work; favor autonomous and creative learning; create new

research strategies, enhance methodological tools and research and learning processes; enrich the teaching and research process and strengthen cooperative and collaborative learning spaces; contribute to train researchers and professionals with human values and committed to society (Villalba and Gonzalez, 2017; Robalino, 2017).

- Institutional research projects, in which students are linked to teachers, serving as assistants. It is frequently used in higher education institutions to integrate teaching and research. In this sense, the preparation of the student is relevant, since he/she must master the methods, procedures and techniques used to collect information; he/she must also know the elaboration of information processing matrices, and be aware of their advantages and limitations.
- Problem Based Learning (PBL) starts from a problematic situation to promote formative research. The teaching or Problem Based Learning is flexible to link Higher Education to the needs of the community. The structure of the solution models follows the logic of scientific research: delimitation of the problem, solution hypothesis, analysis of information allowing the selection of the most probable hypothesis, theoretical, practical or evidence-based validation of the selected hypothesis.
- The design exercises of preliminary research projects on specific topics of a subject. The fundamental aspect of this technique is to acquire the ability to formulate theoretical or practical problems in a given discipline or profession. It is not intended, at any time, that the pre-project is carried out, but that a research process is planned, so that the student becomes familiar with the logic, systematicity and rigor required by research, and with its conceptual and methodological components.
- Cooperative work between students and professors, in which students learn various elements that integrate the methodological and theoretical designs of research, as well as develop skills in field work, having to collect, process and analyze data; they also learn to interpret, discuss, argue, infer, defend results and write reports on the work done.
- The linking of students to faculty research projects, defining precisely the type of participation, the functions that will be performed and the time of execution, but fundamentally the type of product expected. The basic criteria for linkage are: the relevance of the work to be done by the student with the object of the subject or subjects he/she is taking; the level of academic development with the type of product expected; the real possibility of the teacher(s) to offer continuous guidance to the student throughout the research process.
- The research monograph, the elaboration of research monographs, is the most comprehensive technique for developing formative research.
- The pre-professional practice allows students to carry out diagnoses in institutions and organizations related to their future profession and to participate in the solution of problems in these entities, in correspondence with the level of research development achieved.
- The degree works, when the student has a demanding and rigorous advisor that really fulfills the function of advising research. This is when he/she makes reflective comments, when he/she forces to redo parts, to refine concepts and arguments, when he/she guides the comparison.
- Case studies.
- Active learning.

- Project Based Learning.

Formative research model in universities

Antón-Talledo and Antón-Cortez (2019) developed and implemented a formative research program structured in three parts. According to students' semester of study, as part of their comprehensive training model, as a strategy for the development of formative research they opted for the production of basic written texts, essays and monographs; these were raised in level of demand and as a result slight decreases were observed in the grades obtained by students as it advanced in the cycles, due to the fact that each cycle that is advanced poses higher levels of demand in the presentation of final products and greater complexity for the development of the topics. Therefore, measures must be taken to be effective, first to strengthen the basic skills with which students enter the university; then, an academic follow-up must be made from the entrance to the exit of each student, as a quality index, training them throughout the process. Likewise, the teaching work must be strengthened, creating spaces for the awareness of problems and the development of research with students to solve them.

Arévalo-Reátegui (2020) designed a formative research proposal to improve the quality of education at the Intercultural University of the Amazon and identifies the active and synergic articulation between teacher and student as determining axes in the academic process. Formative research should be permanent, based on competency-based training in students, where teaching is carried out through research and teaching-learning processes, with dynamic and proactive characteristics, which encourage students to incorporate into their academic training a highly competent learning model and prepared to enter the highly competitive labor market.

On the other hand, Bulla (2017) proposes a pedagogical model of teaching-learning through formative research, considering interdisciplinary formative research projects as a means of training and a way to integrate the curriculum organized in three levels: cellular, organismic and ecosystemic, corresponding to the third, fifth and seventh semester of training. In addition, a methodological route has been proposed for each project, based on a teaching by research approach in three fundamental stages; evaluation instruments in the form of a rubric were designed to follow up the students' process and the implementation of the project.

Enriquez, Arcos and Mina (2019) developed a matrix as a didactic resource for the teaching-learning process of formative research, the learning of formative research in students through logical reasoning and, above all, to understand the coherence of the research process and to look at scientific research as a systematic and systemic process and leave the fear of research behind. The matrix for planning scientific research is a tool that helps the teaching-learning process devised by the authors, which serves to identify, design and structure the plans to be followed within the planning and execution process of the research project. The matrix contains four large fields, each one referring to the chapters of the research project. Each field is structured by different aspects that are part of the research task.

CONCLUSIONS

Formative research is a type of research that is conducted between students and teachers during the curricular development of a program, and should be present in all learning processes, both in student learning and in the renewed practice of the teacher. The purpose of this type of research is to

teach students, in research, to develop cognitive skills such as analysis, productive thinking and problem solving and to develop pedagogical and didactic knowledge in them to make them more innovative and creative, as well as to build a culture that educates them about the stages of research and the problems they pose. Also, formative research equips students not only with research skills, but also with competencies such as the broad use of language to foster communication, reflection and evaluation of decision-making and attitudes, providing them with their first research concepts and strategies, as well as socializing with their classmates and eventually reaching maturity in scientific research and contributing with new knowledge in favor of society.

On the other hand, universities, in order to develop formative research, have resorted to some techniques, among which the following stand out: theoretical essays, discovery learning, journal clubs, seminars, research seedbeds, institutional research projects, problem-based learning, design of preliminary research projects, monographs, preprofessional practice, graduate work, case studies, active learning and project-based learning.

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