Functionality of research competencies in the application of the Integrating Knowledge Project with undergraduate students

Funcionalidad de las competencias investigativas en la aplicación del Proyecto Integrador de Saberes con estudiantes de pregrados

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Resumen

El Proyecto Integrador de Saberes (PIS) con las competencias investigativas y el desarrollo del aprendizaje colaborativo de los estudiantes se presenta como requisito para superar el problema actual; ellos ya no desean seguir escuchando las disertaciones de sus docentes, sino participar activamente en la construcción de sus aprendizajes. Mirado así el problema, resulta importante, pues, es necesario lograr un cambio en la metodología desarrollada por sus profesores que durante mucho tiempo estuvo sustentada solo en la participación de ellos para que sus alumnos escuchen, tomen notas y se aprendan de memoria para rendir una prueba oral o escrita. Se ha realizado varios intentos de mejoramiento en las diferentes facultades de la Universidad Central del Ecuador, se ha introducido el desarrollo de talleres con el empleo de guías de aprendizaje, que solo se ha aplicado en la ejecución de esos eventos académicos. Sin embargo, para el desarrollo de la teoría, se continúa con la metodología tradicional. Se analiza la incorporación del PIS como una solución más profunda y como una estrategia de aprendizaje innovadora, que cambie el rol de docentes y estudiantes. Los primeros tendrán que asumir la formación de competencias

investigativas en sus alumnos, y los segundos tendrán que desarrollar el aprendizaje colaborativo. Los principales resultados obtenidos son una mejor interacción docente y estudiantes, que conduzcan a un cambio de la metodología utilizada. Las limitaciones que se presentaron fueron que los docentes, con mayor tiempo de experiencia se resisten a cambios innovadores; y los estudiantes, los más pesimistas, no deseaban asumir nuevos retos y compromisos.

Palabras clave

Aprendizaje colaborativo, competencias investigativas, disciplinas –integradas, proyecto integrador de saberes, vinculación-contexto.

Abstract

The Integrating Knowledge Project (PIS) with research competencies and the development of collaborative learning of students is presented as a requirement to overcome the current problem; they no longer wish to continue listening to the lectures of their teachers, but to actively participate in the construction of their learning. In this way, the problem is important, since it is necessary to achieve a change in the methodology developed by their teachers, which for a long time was based only on their participation so that their students would listen, take notes and learn by heart in order to take an oral or written test. Several attempts at improvement have been made in the different faculties of the Central University of Ecuador, the development of workshops has been introduced with the use of learning guides, which has only been applied in the execution of these academic events. However, for the development of theory, the traditional methodology continues. The incorporation of the PIS is analyzed as a deeper solution and as an innovative learning strategy that changes the role of teachers and students. The former will have to assume the formation of research competencies in their students, and the latter will have to develop collaborative learning. The main results obtained are a better interaction between teachers and students, leading to a change in the methodology used. The limitations that were presented were that the teachers, with more time of experience, are resistant to innovative changes; and the students, the most pessimistic, did not wish to take on new challenges and commitments.

Keywords

Collaborative learning, research competencies, integrated disciplines, knowledge integration project, context-linkage, etc.

1. Introduction

The research developed revolves around the functionality of research competencies in the application of the PIS with undergraduate students. The problem has been specifically addressed by trying to answer the question: how does the application of the PIS influence the development of research competencies? To find an answer, this study was based on the perception of students regarding how the application of knowledge integration projects influences the learning of research competencies, and how it contributes to the future professional pedagogical performance of undergraduate students of the Faculty of Philosophy, Letters and Educational Sciences, Universidad Central, Quito, Ecuador.

With this background it is determined that the nature and scope of the investigated problem are around the great university aspiration that is to train professionals in all areas of knowledge to assume the commitment to build functional scientific thinking, and thus respond to current demands (Alarcón et al., 2021; Lema et al., 2022). Scientific research

becomes an essential expertise of teachers and students, who in the teaching-learning processes must transcend the educational practice with autonomy and freedom of expression, based on deep reflection processes.

Considering that research competencies are the key to the new methodology, research promotes the development of research skills in students through: fostering curiosity, critical spirit, inquiry, analysis and reflection. The incorporation of research projects in the curriculum where they explore topics of their interest; the encouragement, collaboration, and teamwork allow them to share ideas, collect and analyze data to present the results jointly; promotes their participation in conferences, and the publication of research papers that favor the mentoring of teachers as experts in their field.

From this point of view, the problem is very important, since it is necessary to overcome methodologies that have ruled for a long time in university teaching, under the premise that teachers only had to prepare well the oral dissertations before their students, and the students had to remain very attentive, silently take notes, which then had to be memorized and presented in an oral or written test. With the current research proposal, the main idea of what we intend to do is to promote the importance of PIS to structure interdisciplinary contents that are articulated with the development of capacities and skills in the cognitive, affective and social areas. This will lead to criteria of curricular flexibility and knowledge that link the university with society within the framework of the defined productive needs, with student participation through scientific research based on a humanistic paradigm of innovation and integral formation of the human being. As a methodological and evaluative research strategy, the PIS is based on the approach and solution of problems related to professional practice and quality of life; for this it requires the articulation of subjects of the level, and career, in teamwork with a systemic vision to discover the connections that the curricular proposal of each discipline raises with concrete learning operations decided with student participation in the construction of new and complex knowledge. In this way, the Universidad Central del Ecuador, Faculty of Philosophy, Literature and Educational Sciences, is framed with its mission in the objectives of the PIS by:

> To train professionals in Educational Sciences, in a humanistic, integral, secular, interdisciplinary, scientific and technological manner, with social, ethical and cultural awareness and commitment; through critical reflection, research and linkage, for the solution of socio-educational problems, with a focus on rights, interculturality, inclusion and equity (Universidad Central del Ecuador, 2020, p. 17).

In this position, the Faculty of Philosophy, Letters and Educational Sciences n:

> It responds to the guidelines of the Secretary of Education, Science, Technology and Innovation (SENESCYT).

> It responds to the guidelines of the Secretary of Education, Science, Technology and Innovation -SENESCYT- which, as an entity of the Ecuadorian government, has the obligation to govern public policy in the areas of its competence. In compliance with its mission, it created the Proyecto Integrador de Saberes -PIS- as a teaching methodology and a learning strategy for the development of research competencies through the approach and solution of professional problems with collaborative work groups (Nivela et al., 2019).

As a consequence of the above, a set of research questions arise. The most relevant are:

- What is the new role that teachers should develop?
- What research competencies should students assume?
- Will the scientific and methodological basis of the PIS be fully accepted by the members of an educational community?

As in all research work, this proposal has some limitations; in the present case, the most latent element is the age and length of service of the teacher; the more experience he/she has in his/her classical conception of teaching, the more difficult it will be to convince him/her to assume a new didactic position. In the case of students, it will be complex to embark them on new processes that demand responsibility and effort in the initial stage, but later they will accept it willingly. The purpose of the article is to contribute with innovative ideas to achieve students with a spirit of research more supportive and committed to their environment, it is no longer the simple repetition of what they have learned in theory, but it is the emergence of their ideas and creativity to accept that their commitment is social in favor of human beings located in a certain context.

This article has been developed considering the following aspects: introduction; literature review: PIS, research competencies, linkage with the context, integrated disciplines, collaborative learning; methods and materials; results; discussion of results; conclusions. Finally, acknowledgements and bibliographical references.

2. Literature review

2.1 Knowledge Integration Project - PIS

It is a strategy that seeks to change the style of teaching and learning in educational centers. Precisely, Rodriguez-Borges (2020) states that:

> The PIS as a methodology is based on the search for strategies and resources to put into practice the theoretical contents taught in the classroom, through an interdisciplinary research project that allows the integration of knowledge and skills of the discipline of the career. The current economic and social context requires professionals with socioemotional skills to work in multidisciplinary teams. Given this demand, the PIS as a methodology becomes ideal, since students must investigate, hypothesize and then provide a solution to a defined problem, from a role of innovators and entrepreneurs, from which they are able to apply knowledge to transform and create, supported by the institution of which they are part, facilitating the development of professional skills and collaborative work (parr. 2).

The PIS seeks to unite theory and practice, in this search, to strengthen the research competencies of students to create in them the predisposition to be entrepreneurial and seek solutions to the problems they face in their university studies and in their future professional practice. Torres (2019) expresses a relevant issue as a previous step to the adoption of the PIS:

> The training process has been fundamentally focused on teaching, in which the only one who knows is the teacher, who transmits his knowledge to the students of what he knows or has mastery of, with traditionalist strategies. On the other hand, students assume a passive

> attitude towards their learning, they become mere receivers of information and repeaters of what they have learned, the master class predominates and the evaluation is focused more on the result than on the process (p. 63).

This methodology is no longer desired by students, who prefer to be more participatory entities during the teaching and learning process. The PIS as a methodological strategy contributes to the formation of professionals capable of facing the challenges of today's world, and who can apply their knowledge in real situations (Pereira, 2019). PIS fosters creativity, innovation and allows students to develop a global vision of their profession. Toapanta-Pinta (2021) emphasizes that "the knowledge integration project (PIS) is a research exercise under teacher mentoring, where the student acquires knowledge; it constitutes a new teaching-learning methodology" (para. 1). It is reiterated that it is a new teaching-learning methodology based on teacher tutoring. It implies that the two fundamental actors: teachers and students must be predisposed to a change of methodology.

2.1.1   Phases of a knowledge integration project

The PIS is carried out in three fundamental phases: preparatory, development and evaluation of results.

Preparatory phase, with some emerging actions: analysis of the curriculum at macro, meso and micro levels; determination of the current situation in the career; formulation of the contents to be integrated with the identification of theories, knowledge and competences; designation of tutors to carry out the process with their due training.

Development phase, which basically covers the elaboration of the project, its implementation and development in practice, assuming the successes and difficulties that will arise, for which it should be socialized among all participants.

Results assessment phase, as a very responsible activity, the results, both positive and negative, should be presented in order to receive feedback from all those involved and at the same time motivate to continue incorporating more participants in the process (López-Peña, 2017; Torres et al., 2020).

It is a process that responds to the main stages of an innovation project. The initial conditions must be analyzed to specify the situational state in which the venture is taken, and in accordance with this reality foresee what must be considered to ensure future success. This is followed by the execution phase; during this stage, all the successes and difficulties encountered should be socialized. Limitations are aspects that, if well managed, motivate and involve most of the participants. To reach the last stage, in which all the results obtained should be externalized, in order to have a valuable input for the future.

2.1.2 Advantages of the application of the knowledge integration project

The knowledge integration project constitutes a valuable contribution to the curricular innovation of the different careers of the Faculty of Philosophy, Literature and Education Sciences of the Universidad Central del Ecuador, because:

> The PIS is an innovative proposal that facilitates student participation in research processes.
>
> It uses critical pedagogy to facilitate the relationship between research, teaching and community involvement.

It allows gathering the reality of educational institutions regarding their problems and difficulties.

It contributes to the professional training of future teachers through collaborative work.

Develops students' critical thinking, linking them with the educational reality from the beginning of their studies.

It emphasizes research as an element of reflection of the educational reality.
It considers self-evaluation, co-evaluation and heteroevaluation processes in the evaluation (Calderón-Guevara et al., 2021, pp. 10-11).

2.1.3 Limitations in the application of the Knowledge Integrating Project
These same authors are very self-critical when they express a series of difficulties that arise during the implementation of an ISP. They are listed below:

There are no precise procedures to evaluate the progress of an Integrating Knowledge Project; they must be elaborated with the direct participation of teachers and students.

Research skills must be developed, considering that students are subjects that must be gradually trained in this area.

It is necessary to deepen the knowledge of interdisciplinarity as the axis of development of a PIS.

It is difficult, in certain occasions, to overcome the separate vision of the subjects, on the part of the teachers; for the students there has been no other vision.
It is difficult for teachers and students to work in a different way, they break their previous schemes (Calderón-Guevara et al., 2021, pp. 10-11).

2.2 Research competencies
In the application of the knowledge integration project, research competencies are a key element in the activities of teachers, students and the educational community. In the pedagogical pre-professional practice of higher education, they are a transversal component that generates teaching-learning experiences by discovery and construction of knowledge, focused on the potential of each student (García-Gutiérrez and Aznar-Díaz, 2019; Torres et al., 2019).

The indispensable research competencies for future higher education professionals may vary according to authors, theoretical perspectives and methodological requirements. Those identified in recent literature stand out: research design and development, use of tools and technologies, effective communication, critical and reflective thinking, teamwork and collaboration, ethics and responsibility (Hernández et al., 2019; Perozo et al., 2019).

In the different careers and specialties of higher education "it is necessary to strengthen the research competencies of teachers, so that they build in their daily pedagogical practices an

investigative environment, that they are concerned about educational innovation and their own self-training as professionals" (Perozo et al., 2019, p. 93). These investigative competencies have an "integrative character, they develop cognitive, affective, and procedural dimensions that enhance a positive attitude, interest, self-confidence and self-regulation" (Erraéz et al.,2020; Ravelo at al., 2019). In school classrooms, the application of these competencies enables students in the fulfillment of their pre-professional practices to learn to be critical, reflective and autonomous by acquiring skills and abilities to discover, investigate and construct knowledge (Álvarez, 2019; Buendía-Arias et al., 2018).

In the learning process, research competencies are acquired and perfected in a sequential and permanent manner. The following lines explain those suggested for students in early childhood education, basic general education and unified general baccalaureate. Specific primary competencies for children in initial and general basic education: observation and recording, formulation of questions, collection and organization of information. Their learning builds capacities to elaborate accurate descriptions of what they see, especially of their immediate world, develop inquiry and curiosity skills, identify problems and pose solutions with skills to communicate their findings and ideas orally or in writing with clarity and coherence (Buendía-Arias et al.,2018; Coral, 2021).

The competencies for baccalaureate students vary depending on the discipline and area of study. Its objective is "to connect domain-specific educational research with the development of teaching practices. Its basis, is the systematic use of empirical research evidence that connects to transformative teaching actions" (Rodelo et al., 2021, p. 289). The most important research competencies are: identification of the problem, search for relevant, pertinent and updated information, research design and planning, data collection and analysis, interpretation and discussion of results, communication and dissemination of results (Zacarias, 2021). At the conclusion of the PIS application process, it is expected that teachers in training develop competencies to question, observe, reflect, with propositional, technological, interpersonal and communicative skills because new professionals should not only possess the working knowledge of their area, but and above all, demonstrate abilities, attitudes and skills, which allow them to discover problems, and creatively propose possible solution alternatives, based on the knowledge incorporated in their professional training (Márquez-Specia et al., 2019). In this regard, Butigué et al. (2021) state that.:

> For teachers in this knowledge society, where information and technological advances are occurring at an ever-increasing speed, it is essential that teachers possess research skills in order to be up-to-date and offer a quality education to their students because research skills allow teachers in interaction with students to identify educational problems, design research projects, collect and analyze data, and draw conclusions and recommendations based on evidence (p. 84).

The learning of research competencies is done through pedagogical strategies that facilitate the application in pre-professional pedagogical practice, activating factors such as motivation, usefulness for life, problem solving. In addition, it is important to consider that its teaching should not be isolated, it should be integrated in the teaching-learning process in a transversal way.

2.3 Linkage with the context

In the PIS, the linkage with the context opens spaces for local, regional and global communication. It is a structural element in the formation of students, it supports: the

positioning of universities in the immediate context, the knowledge of the political, socio-cultural and economic reality of the country, the teacher-student interrelation with research and dissemination of scientific and technological knowledge in professional practice. In the social field, "Higher Education Institutions (HEIs) are agents that adapt to global demands according to their capabilities and the opportunities provided by the environment" (Atrizco and Martínez, 2022, p. 2). The academic practices of university-society linkage are recognized in agreements that urge HEIs to become actively involved in solving the social, environmental and sustainable development challenges of their respective countries and communities (CRES, 2018). The UN 2030 agenda for sustainable development highlights the importance of universities in achieving the sustainable development goals and requests HEIs to contribute to the solution of global challenges (Andrade et al., 2020).

Also, legal instruments recognize the value of the link with society: Organic Law of Higher Education (LOES), "Art. 13. The functions of the Higher Education System are: a) To guarantee the right to higher education through teaching, research and its link with society, and to ensure increasing levels of quality, academic excellence and relevance..." (SUPERIOR, L. O. D. E., 2018, p. 18). General Regulations LOES Art. 24.- Liaison with society. - The linkage with society refers to the planning, execution and dissemination of programs and projects that guarantee the social responsibility of higher education institutions and their effective participation in society in order to contribute to the solution of the needs and problems of the environment, from the academic and research environment (León et al., 2019).

In practice, the Faculty of Philosophy, Letters and Educational Sciences identifies the needs and problems of the context, establishes strategic alliances with social organizations, institutions and local businesses, designs projects that involve students in their implementation and evaluates the results on an ongoing basis to determine which are the most urgent needs for solution (Peralta, 2020)..

At the international level in the United States and Europe, the following are successfully developed: service-learning; professional internships in real contexts; volunteer programs and participatory research are programs that allow students to acquire competencies and skills for their future professional practice (Serrano and Roig, 2018).

As can be seen, the importance of the linkage is one of the university's tasks that is growing as the practice experiences advance and become more generalized in that:

> in the context of Ecuadorian higher education, the link with society has become a factor of interaction and strategic intervention in the local, regional and national socio-political and cultural development, making possible a high quality training that tends to excellence and relevance of the Ecuadorian Higher Education System and consequently of its students in training and graduates (Barreno et al., 2018, p. 44)..

The link with society is thus a permanent challenge for HEIs because it has created social relevance in pedagogical practice. In this research they have experienced new perspectives of action that teachers and students are inserting in their daily actions as new work alternatives or perhaps as lines of research. The pending challenges are enunciated with an approach of activities that are to be fulfilled: to create work connections between the productive and educational sectors, respecting the social needs of the community, their knowledge, an element that will generate empowerment, from the pre-professional training

of students and in the pedagogical practices of academics, a means to become aware of the reality in the solution of problems at local, regional and national level (Valencia, 2021).

To propose projects that allow understanding linkage as a social and human phenomenon, and a transforming activity that is constituted in the process of change of (HEIs) with an integrative approach (Barreno et al., 2018). Organize projects that allow the incorporation of strategic alliances of inter-institutional cooperation to manage the linkage with society in places that require external support due to their precarious reality (Ayala and Sanchez, 2021). Train those responsible for the operation of the system of linkage with society, in a conceptual and technical manner with the participation of all sectors of society. Create research councils that systematically gather the opinion of the social and productive sectors to create new lines of research and enrich the policies established by the authorities and bodies responsible for coordinating the linkage with society in the HEIs. Organize events: workshops, talks, presentations, congresses, at national and international level, for the exchange of successful experiences of linkage in higher education, so that the socialized production becomes a theory of linkage with society in a work of social praxis. The linkage with society as:

> One of the challenges of higher education is to solve and dissipate these challenges through the interaction of university students, authorities and teachers in general, who are in charge of executing projects that are duly planned, organized, executed, controlled and the respective follow-up of this process (Once et al., 2020, p. 251).

The research shares the need to plan processes that relate academic aspects, research and linkage with the context, as interdependent elements to prepare future professionals with an integrative approach that will allow them to put into practice what they have learned in the future, in accordance with the provisions of relevant laws and regulations.

2.4 Integrated disciplines

In the process of curricular organization, the integration of disciplines is an educational approach that changes the current paradigm, it seeks to integrate different areas of study to "show them a holistic view of knowledge, presenting cores of content analyzed from different areas of knowledge" (de Pablos et al., 2019, pp. 150-151). To achieve this objective in the knowledge integration project, it was necessary to develop interdisciplinary activities that involve teachers and students in the structure of the learning topics.

The process was planned in two stages: the first to raise awareness of the need to change teachers' opinions, an aspect that was complex and required a continuous and sustained effort; the second with the objective of planning the curricular development of each specialty in the different careers with the participation of pre-professional practice students. The basic activities are summarized below.

First stage:

- Organize interdisciplinary workshops and meetings. The events are an opportunity for teachers from different disciplines to discuss and share existing experiences on curriculum integration (Majjul, 2022). It is important to highlight the use of various tools and strategies to address integration in the classroom.

- Apply interdisciplinary research. Research competencies motivate the management of a set of activities in which teachers from different disciplines participate around a topic of common interest (Zapata, 2021). Interdisciplinary research projects involving teachers and students from different careers and specialties are planned.
- Create interdisciplinary working groups. The interrelation between teachers from different disciplines is an opportunity for them to meet on a regular basis to discuss and develop curricular integration activities. These groups are led by teachers committed to integration, collaboration and teamwork (Guzmán, 2019).
- Encourage interdisciplinary feedback and evaluation. The results generate curricular tools for the integration of disciplines, and also allow socializing experiences on joint activities as a basis for the sustainability of the Integrating Knowledge Project with a creative approach to improve the quality of education (Jarquín, 2022)..

The importance of planning with integrated disciplines is recognized for a change in the culture of teachers and students of higher education, where it is necessary to manage an updated theoretical framework as a support tool in the curricular work of each career and specialty (Torres et al., 2021).

The practice experience allows discovering that the concept of integrated discipline is a key element of the interdependence of the factors to be integrated, establishes the points in common, creates fabrics that reinforce the union networks, generate adhesion without agglutinating or bundling them because they organize the learning contents through a curricular planning that works as a system (Medina-Zuta and Deroncele-Acosta, 2019).

Second stage:

- Conduct interdisciplinary research projects. Students work together to analyze a topic in depth, based on the results of research in pre-professional communities of practice: they use tools and knowledge from different areas to do so (Ramos, 2015).
- Participate in interdisciplinary discussions: Students discuss current or controversial topics from the theoretical assumptions of each subject of study to foster understanding and respect for different points of view depending on the specialty (Jarquín, 2022).
- Prepare interdisciplinary simulations: Students simulate complex situations that require the collaboration of different disciplines for their resolution. It is worth highlighting the positive results of this activity, especially due to the tutoring provided by the teachers of the different curricular disciplines (Lescano, 2020).
- Elaborate community service projects: Students develop projects that address real problems of the practice sites with the management of knowledge from different areas to find innovative solutions (Jácome-León and Ilvis-Vacacela, 2020).).

The process of disciplinary integration is a formative methodology because at the same time that it teaches, it allows the application of what is suggested in the theory. It is based on the following principles that enhance the organization of integrated disciplines with a holistic approach: principle of attention to the foreseeable professional profiles required to determine the competences proper to the profession; principle of oral, written communication and interpersonal relations, it refers to creating a culture of debate, exposition of results, teamwork and development of scientific work; principle of attention to the specificities of science that propitiates to raise optional subjects where the most updated contents are reflected for the resolution of real problems (Medina-Zuta and Deroncele-Acosta, 2019).

Teachers recognize the importance of integration activities for their results in relation to the academic development of students because they become authors of the Integrating Knowledge Project with teacher mentoring, mobilize a set of resources, value and evaluate the achievement of their competencies and understand that planning with integrated disciplines is an action of "metacognition conceived as a structure where the multiple skills, abilities, knowledge and competencies that teachers need for their performance as teachers have a place" (Torres et al., 2021, p. 135).

2.5 Collaborative learning

The main element for incorporating new teaching-learning strategies in Ecuadorian higher education is the introduction of collaborative learning, which, in essence, is to form teams among students of a subject in the curriculum of a career to take on a problem, search for scientific information, jointly determine causes and consequences of that problem, and build the alternative or alternatives for a solution. The role of the teacher in this new methodological position is to help the organization of collaborative learning groups among students, providing them with updated scientific information.

In this regard, Guerrero and del Campo (2019) state that.:

> Collaborative learning activities include, among others: knowledge integration projects, construction of models and prototypes, problem solving and problem or case resolution projects, systematization of research and intervention practices, which include learning methodologies, with the purpose of promoting the use of diverse information and communication technologies, as well as network methodologies, on-site tutorials or virtual environments (p. 134).

Collaborative learning presents a variety of situations to develop it, all aimed at greater student participation. Morillo (2021) states that "collaborative learning has become a much more suitable way of acquiring new knowledge. This educational approach seeks to enable people to learn actively, but in direct contact with other individuals with particular interests" (para. 1). It is a way of learning in communion of objectives, ideas, and interests among students at the same level. On this level, the teacher's role is different. They must provide them with updated, varied and valid information so that their students can incorporate new knowledge.

Another author clearly maintains that there is a direct relationship between the development of a knowledge integration project and collaborative learning. Rodriguez-Borges (2020) states that:

> The PIS as a methodology becomes ideal, because students must investigate, hypothesize and then provide a solution to a defined problem, from a role of innovators and entrepreneurs, from which they are able to apply knowledge to transform and create, supported by the institution of which they are part, facilitating the development of professional skills and collaborative work (p. 240).

These authors insist that the PIS provides the theoretical and methodological basis for students to take on the challenge of facing a problem in their environment, which is curricularly linked to one or more subjects of the course they are studying, and to do so through the use of collaborative work. This task involves the students in the search for the antecedents and consequences of the problem and the proposal of possible solutions.

In summary, collaborative learning has some characteristics: it is based on the interaction of the members of the group; it achieves synchrony of interaction. Each member of a collaborative learning group reflects and issues value judgments on the achievements obtained in collaborative learning; there is a positive interdependence, the effort of each group member benefits everyone equally. A commitment to group success is created, individual achievement does not appear; it produces a stimulating interaction, all members of the group must share the information found and analyze together the possible benefits in favor of the work they are developing; they must work to achieve consensus around the purposes that have been set. This type of learning enhances individual and group responsibility, which gradually benefits the consolidation of a climate of trust (Damián et al., 2021; Jaramillo-Valencia and Quintero-Arrubla, 2021; Sepulcre, 2021; Sepulcre, 2021).

At the end of each stage of the process, the teacher must know how to lead the students, so that they carry out a group evaluation, not an individual one, and thus avoid competitive processes. It is worth highlighting the benefits that collaborative learning offers, in a very specific way, it can be stated that gradually decreases the fear of new learning, students gain confidence that everyone grows. In addition, it develops critical thinking, as each of the students express their ideas, not in a mechanistic way, but with arguments that make their way of thinking known. Consequently, with this position, the teacher must ensure that, for the fulfillment of a task, all students must assume the commitment; for this purpose, he/she will be prepared in the search for stimulating actions so that all participate with enthusiasm from their possibilities. What must be avoided is the emergence of gifted positions.

The detractors of this learning strategy put forward three key ideas: the participants with a lower development of potentialities will be disadvantaged, they will not be able to catch up with the more advantaged ones. Another detrimental aspect is that teachers, in some cases, are not prepared to lead this process and avoid leaving their comfort zone, give their classes orally, and not all institutions have facilities to make virtual strategies available.

3. Methods and materials

The research work was carried out under a quantitative and qualitative approach, with the purpose of collecting impressions and thoughts of students and teachers. The survey technique was used with the students and its instrument was the questionnaire, while for the teachers the interview technique was used with its respective guide. In order to make this decision, precise information was sought from renowned authors, as Hernández-Sampieri (2020) states that "the research problem under the quantitative approach allows analyzing phenomena, emphasizing their quantitative dimension, as well as describing these phenomena from the point of view that they have already been explored" (p. 26). Objectivity in the interpretation of the results is determined with numerical information, synthesized in frequency tables, percentages and graphical representation, which allows establishing comparisons and exposing future projections, based on previously collected data.

In qualitative research, Fuentes-Canosa and Collado (2019) indicate that in this approach "the processes of creation and organization of knowledge have an essential communicative component, which makes it possible for more users to access and take advantage of this knowledge" (p. 159). It is also explained that in all scientific research there must be validity and reliability criteria, related to: reflexivity, previous experience of the researcher in the study context; credibility, permanence of the researcher in the study center; transferability, possibility that the results can be applied in other contexts; dependence, that the research can be repeated in other environments with the same instruments; and, confirmation,

presentation of evidence in fragments of the discourse collected in the interviews (Diaz, 2019). In Table 5 of results, the ideas expressed by the teachers in the in-depth interviews are visualized, in which what was expressed by (Diaz, 2019) is confirmed. Quantitatively, 714 students of the Faculty of Philosophy, Letters and Education Sciences, of the Central University of Ecuador were investigated, classified into 523 males and 191 females, these students, with a questionnaire of 13 questions, each one with four alternatives to issue its corresponding answer. The questionnaire initially posed questions related to the sociodemographic dimension: gender, age, career, semester in which they are located, whether they work or not, if they work whether they are located in an area related to what they are studying, place of birth. These students came from the careers in which they were selected. Data visualized in Tables 1, 2, 3 and 4 of the results.

In the qualitative research, the teachers were selected from the following careers: Early Education, General Basic Education, Educational Psychology and Guidance, Pedagogy of History and Social Sciences and Pedagogy of Experimental Sciences, Mathematics and Physics, after receiving an initial explanation, they expressed their informed consent and commitment to confidentiality. The questions referred to the different aspects of the knowledge integration projects, as follows:

- What are the most significant aspects of the knowledge integration projects for the future professional performance of your students?
- How do you integrate the disciplines of the different subjects of the syllabus for the integration of knowledge?
- Which research competencies helped the students in a more significant way in the development of the knowledge integration projects?
- List the aspects that most hindered the development of research competencies in the knowledge integration projects?
- From your experience, what would you suggest to improve the current processes of the knowledge integration project??

There are similar opinions in the responses, so the most relevant ones were selected, as explained in Table 5. The answers were very enriching, the teachers responded in a broad manner.

4. Results

Table 1 shows the students' perception of how the application of the PIS contributes to the learning of research competencies, as evidenced by the results of the following questions.

Alternative	Quantity	Percentage	Rounded percentage
Always	267	37.4 %	37 %
Frequently	292	40.9 %	41 %
Occasionally	141	19.7 %	20 %
Never	14	2.0 %	2 %
Total	714	100 %	100 %

Table 1. Did the PIS, the teacher developed with his participation and allowed him to acquire research competences?

The results showed that 78% of the respondents (between the options of always and frequently) stressed the importance of student participation in the development of research competencies, while 22% responded with the options of occasionally and never. Data that

confirmed that learning is preparing for life with the acquisition of research competencies, to face problems, solve them and participate directly in the satisfaction of achieving academic achievements. Table 2 showed that the previous integration of disciplines supported learning in a functional way.

Alternative	Quantity	Percentage	Rounded percentage
Always	240	33.6 %	34 %
Frequently	334	46.8 %	47 %
Occasionally	122	17.1 %	17 %
Never	18	2.5 %	2 %
Total	714	100 %	100 %

Table 2. With the application of the integration of disciplines, does learning become more functional?

Thirty-four percent of students placed themselves in the option always; 47% in frequently; 17% in occasionally and 2% in never. These results are analyzed from a double perspective: that of teachers empowered with the integrative model, who constitute an example recognized by their students. And that of the teachers who wish to maintain their comfort zone, issuing their knowledge orally, as the sole owners of scientific knowledge, where most of the students no longer wish to continue. Table 3, referring to the use of the PIS by the teacher as a collaborative learning strategy, facilitates the organization of work teams, optimizes the relationship between teachers and students with the attainment of achievements that improve learning results and enhance the performance of each team member, eliminating competitive positions.

Alternative	Quantity	Percentage	Rounded percentage
Always	350	49 %	49 %
Frequently	253	35.4 %	35 %
Occasionally	91	12.7 %	13 %
Never	20	2.8 %	3 %
Total	714	100 %	100 %

Table 3. Is the PIS used by your teacher as a collaborative learning strategy applied by organizing work teams?

Forty-nine percent stated that this strategy is always applied; 35% selected the option frequently; 13% the option occasionally and 3% responded never. It was evident that most of the students supported collaborative learning, where, divided into small groups, they developed their research potential, determined the background of a problem, envisioned its possible consequences and collectively established tentative solutions. Table 4 shows that the PIS prepared students to participate in leadership and community outreach processes when they graduate from the program.

Alternative	Quantity	Percentage	Rounded percentage
Always	311	43.6 %	44 %
Frequently	267	37.4 %	37 %
Occasionally	109	15.3 %	15 %

Never	27	3.8 %	4 %
Total	714	100 %	100 %

Table 4. Is the PIS a vehicle so that when you graduate from the program you will be able to lead processes of innovation, transformation and linkage with society?

The option of always was answered by 44 %; frequently was answered by 37 %; occasionally answered by 15 % and never was the answer assumed by 4 %. The difference between the majority and minority options is notorious, which is favorable for locating leadership processes. It is reiterative the confirmation that the development of the PIS will influence pre-professional preparation, an innovative methodology that trains them sequentially and continuously to acquire knowledge, skills and competencies that will facilitate the task of leading community participation processes in their future performance. Consequently, teachers must be prepared to coordinate the elaboration of the different projects in the field work, linking the members of the immediate environment in the analysis of the problems as a key element of the university-society linkage. Table 5 shows the results of the criteria expressed by the teachers in the in-depth interviews (qualitative approach) through an interview guide, whose comments are summarized as follows:

In-depth interview guide	Teachers interviewed	Comentaries
1. What are the aspects of the PIS that are very significant for the future professional performance of your students?	Pedagogía de las Ciencias Experimentales: Matemática y Física Psicología Educativa y Orientación Educación General Básica	I conceived the teaching of Mathematics and Physics in a different way, putting the knowledge in function of the community reality. PIS as a methodology is ideal because students investigate, hypothesize and solve specific problems with mutual agreements. It contributes to the training of professionals by confronting them with the challenges of today's world by applying their knowledge in real situations.
Which research competencies helped students most significantly in the development of the PIS?	Initial Education History and Social Sciences Pedagogy Experimental Sciences Pedagogy: Mathematics and Physics	Special emphasis on: posing questions in simple language; selection of updated scientific information; and learning strategies for data interpretation. Strengthening of research competencies with an integrating character of the active cognitive and procedural dimensions. I learned to work with a holistic vision of knowledge integrating content cores.
What are the aspects that most hindered the development of research competencies in the PIS?	Pedagogy of History and Social Sciences Educational Psychology and Guidance Pedagogy of Experimental Sciences: Mathematics and Physics	The aspects that made it difficult can be summarized as: difficulties in formulating research questions; and, inexperience in the interpretation of results. Applying interdisciplinary research, teachers did not agree on integrating curricular activities. Poor ability to demonstrate professional skills in collaborative work. Linking pedagogical practice with the needs of the immediate community environment.
According to your criteria,	Educational Psychology and Guidance	Rescue the importance of psychological knowledge by providing constant and timely feedback

which aspects applied by you contributed the most to the success of the students in the application of the PIS?	Initial Education	throughout the process, as well as fostering collaboration between students, teachers and the community. To propose projects that raise awareness about the reality in the solution of local problems.

Table 5. Teachers' comments in the in-depth interviews.

4.1 Triangulation of esults

It consists of a methodological strategy that guides the reception of data to strengthen the reliability and validity of the findings. Below is a matrix that correlates the quantitative data from the student questionnaire with the qualitative data from the in-depth interviews with teachers. In both cases, the most relevant information has been selected

Objective	Ítems de Resultados		Correlation
	Students	Teachers	
To determine the theoretical foundations that support the PIS in the initial formation of students of the Undergraduate Careers of the Faculty of Philosophy, Letters and Educational Sciences.	5, 12, 13	2, 9, 10	Both students and teachers prioritize: • The formation of learning communities to apply the theoretical foundations of the PIS in the training of future professionals. • The interrelation of disciplines to favor the transformation of the educational process. • The importance of monitoring and innovation in the improvement of processes.

To verify if the learning of research competencies generates appropriation and integration of knowledge in the learning outcomes. .	4, 6, 9, 10	1, 3, 7	Teachers give importance to the PIS as a tool for learning research competencies that facilitate interdisciplinarity between contents of different subjects. This criterion is also shared by the students who ratify its importance in the learning outcomes.
Value the experiences developed in the PIS with collaborative learning as a contribution to the improvement of the curricular proposal.	7, 8, 11	4, 5, 6, 8	Collaborative learning makes students the actors of their own learning. Most students prioritize the effectiveness of collaborative learning; however, 13% request that lectures be replaced by team work with teacher-student interaction. Data confirming the consistency and convergence of the information collected.
What are the pedagogical strategies that you applied to achieve the linkage with the community context in the implementation of the PIS??	General Basic Education Pedagogy of History and Social Sciences		Carry out some pedagogical strategies, including constant accompaniment in the process, timely and accurate feedback with the creation of opportunities for collaboration among them. Organize workshops and discussions to socialize successful experiences.

Table 6. Correlation of Results

5. Discussion

The research data from both teachers and students prove that the PIS is a methodological strategy for the permanent transformation of the educational process with strong support for the development of research skills. They reaffirm what has been expressed by researchers that "research skills constitute a demand in the training process in the university student..., the knowledge society... demands new profiles to address the requirements of an increasingly demanding occupational market and in accordance with its needs" (Barbachán et al., 2020, p. 96). This pre-professional preparation allows them to develop their creativity and innovation, skills that are essential for their future performance, in any field that requires the ability to solve complex problems creatively.

Also, the research confirms what is expressed by Torres et al. (2019) who consider that "initial teacher education must go through an internal process of reorientation and personal transformation, which takes advantage of and builds on previous acquisitions and precedes lasting and sustainable external change" (p. 47), because it links theory with practice in the development of research competencies, which "enable teachers in interrelation with students to identify educational problems, design research projects, collect and analyze data, and develop conclusions and recommendations based on evidence" (Butigué et al., 2021, p. 84). This experience is confirmed by (Guzmán , 2019; Herrera-Durán and Castro-Carrasco, 2021). The PIS with the development of research competencies becomes an innovative strategy that confirms what is stated by UNESCO (2009) which defines, in general terms, competence as: "the educational strategy based on the identification,

evidencing and learning of the knowledge, skills, attitudes and behaviors required to perform a specific role, exercise a profession or carry out a given career" (p. 1).

Regarding Collaborative Learning (CL), the results are an important finding because "CL is directly and systematically related to the practical component..., in works that integrate the contents of the subjects in the form of projects" (Guerrero and del Campo, 2019, p. 136). Its effectiveness is confirmed by a teacher of the Faculty when in the in-depth interview he expresses: "collaborative learning... is overcoming the conception of the teacher who only gives expository lectures..., his new role is that of a trained guide..., to form collaborative groups..., that exchange opinions among students who are the builders of their knowledge" (Results of the interviews developed with teachers, 2022, p. 199...).).

6. Conclusions

The research values the functionality of research competencies in the application of the PIS with undergraduate members and becomes a proposal that deserves to be incorporated as suggested by SENESCYT, since it requires a set of "more accurate methodological and research supports, so that, from a curricular fabric, harmoniously built, it guarantees the approach to science with a sense of social responsibility and knowledge production, which is enriched from experience and transformed into it" (SENESCYT, 2013, p. 1; Quinatoa, 2019; Registro Oficial N°227, 2023).

The research provided an answer to the problem of how to go from theory to practice, based on the theoretical assumptions established by different national and international organizations and the UCE itself, on how to reach agreements between careers to apply what is foreseen by SENESCYT, which suggests unifying contents in an interdisciplinary work, achieving the link with the context, encouraging teachers about their change of role and involving students in this process. The PIS practice facilitated teachers and students to integrate curricular contents to modify learning outcomes, as an academic action that allowed developing research skills and applying knowledge effectively in the pre-professional internship work. The application of creative strategies for the integration of disciplines, collaborative learning and linkage with society, as basic aspects of the methodology, were fundamental for the success of the PIS. Teachers and students emphasized the importance of creating an interdisciplinary and collaborative work environment because they shared knowledge, experiences and learned from each other.
The functionality of the research competencies when correlated with the PIS shows that this academic effort should continue to be deepened in the conceptual and methodological dimensions in the different faculties of the Universidad Central del Ecuador. Under the approach of the research line of institutional collaboration, the PIS should be strengthened among different universities in the country so that teachers and students can exchange experiences, achievements, limitations, and improve the processes in a permanent way..

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