

# Retroactive and generative loops in the narrative construction of pedagogical and didactic knowledge of teachers in university contexts

Lewis Herney García Mora  
Magister en Educación y Desarrollo Humano  
Universidad Santo Tomás,  
Bucaramanga, Santander, Colombia  
Correo electrónico del autor: Lewisgarcia@gmail.com  
udcfdcurricular@ustabuca.edu.co

Artículo recibido: julio 15 de 2019  
Artículo aprobado: agosto 22 de 2019

## Cómo citar este artículo:

García, L. H. (2019). Retroactive and generative loops in the narrative construction of pedagogical and didactic knowledge of teachers in university contexts. *Espiral, Revista de Docencia e Investigación*, 9(2), p. 109 - 130.

## Abstract

This research article shows the final results of the research project "Construction of knowledge on teaching practice at Santo Tomás University – Bucaramanga: A contribution from the paradigm of complexity", which seeks to show the construction of pedagogical and didactic knowledge from said paradigm, based on the recognition and reflection on teaching practice narratives. As a methodology, a research based on an interpretative approach with a narrative design was proposed. The data were collected through semi-structured interviews analyzed with the support of Atlas.ti software; the interpretative model was based on the categorization of units of meaning from the categories of recognition and reflection, followed by a description, interpretation and conceptualization. Seven main teaching strategies and actions were identified as implemented by teachers: project-based learning; integrating project; workshops and collaborative groups; practices and use of laboratories; use of ICT; classroom research, and use and production of support material. The reflections revolved around: teacher planning; concepts, implementation and training in the institutional pedagogical educational model; teacher training; academic performance; monitoring of learning, strengths and weaknesses. It was concluded that pedagogical knowledge is the result of the reflective processes or the practice the teacher carries out on the planning, development and evaluation of the

formative process. Pedagogical and didactic elements are interwoven there in a simultaneous, complementary and antagonistic way, constituting their complex character.

**Keywords:** Complexity, University Didactics, Teaching knowledge, Pedagogical knowledge.

## Introduction

The following article presents the results obtained from the research of the doctoral thesis in complex thought, which sought to identify the construction of *pedagogical knowledge that, based on the narratives of fifteen university professors, was understood from a perspective that articulates knowledge of pedagogy interpreted from the principles of the paradigm of complexity. From there, an attempt will be made to integrate and link different teaching reflections in a collective of pedagogical knowledge, understood as a: "joint fabric that makes up an interdependent, interactive and inter-retroactive totality" (Morin, 1999).*

Due to the above, we tried to identify and reflect on the pedagogical practices that constitute a plexus of interdisciplinary interest with the intention of *knowing more and better orienting* the teaching-learning processes in higher education. The following question is posed: How can *pedagogical knowledge be constructed to promote the integral formation of the students of the Santo Tomás University - Bucaramanga?*

In view of this question, the objective is to build *pedagogical knowledge through the paradigm of complexity* by means of the recognition and reflection of pedagogical practices by one of the actors in the educational process: teachers. In order to achieve this undertaking, specific objectives are proposed, as follows: To characterize the pedagogical practices of a group of teachers and students at Santo Tomás University - Bucaramanga; to describe the reflections of the actors of the educational process, teachers and students at the University in relation to the pedagogical practices implemented; to build *pedagogical knowledge from the understanding of the teachers' reflections on their pedagogical practices in the light of the principles of the paradigm of complexity* (Morin, 1994).

### Conceptual references

The theoretical or conceptual references that support the epistemological and pedagogical understanding of the proposal integrate four sections. First, we find the arguments referring to Teaching Practices and Teaching with authors such as De Lella (1999), who refers to teacher's or educational practice as associated to teaching, and the difference between the general institutional work and the social practice of teachers. However, Colomina (2001) proposes a vision of teaching practice from a more open and integrated perspective, including planning, development and evaluation of training. On the other hand, Zabala (2020) rescues the notion of interactivity in educational practice,

recognizing the interdependence of the subjects of education in the three moments of the educational act.

Coll and Solé (2002) refer to the concept of educational influence, particularly from the teacher to the student, as those elements that support the learning process of students before, during and after the teaching situation, and, on the other hand, the notion of the interactive teaching triangle.

Likewise, García, Cabrero, Loredó and Carranza (2008) propose practice as a reflexive process focused on the analysis of the interaction between teacher and student in the three moments of the training process and that, in order to understand educational practice, the dimensions of the teacher's didactic thought and its expression in the planning processes, the educational interaction in the classroom and the reflection on the results achieved should be studied. The above should be used, according to the authors, in the teacher training processes.

For the category of Pedagogical Knowledge, we take up again the contributions of Zuluaga (2006) who defines it as a set of knowledge and practices that consolidate a hegemonic discourse that is necessary to identify in order to advance towards the construction of diverse expressions and methodological applications of didactic designs and sequences; thus, the conceptual body of pedagogical knowledge would be under construction through research, reflection and transformation. For this author, the practice and the knowledge about it are linked aspects and one evidences the other. On the other hand, Almonacid, Merellano and Moreno (2014) conceive pedagogical knowledge as a narrative, paradigmatic and ideological deployment that gives sense to the educational action; for them, it is a corpus of pedagogical, didactic, professional and disciplinary knowledge. In this way, pedagogical knowledge implies knowledge about the curriculum, practice and reflection. For these

authors, pedagogical knowledge goes beyond what is disciplinary or pedagogical-didactic; it is the product of a reflexive action, which improves the learning process in the classroom.

Sánchez and González (2016) propose that pedagogical knowledge has to do with knowledge of the objects, models and theories of pedagogy, the set of relationships between teacher and student, and the knowledge between these relationships. For them, pedagogical knowledge is built by each one at different levels; conversely, Díaz (2006) proposes that to reach it, it is necessary to do research on educational action to break with the belief of training to teach and not to train to investigate and to reconstruct the pedagogical action. González and Ospina (2013) review this notion and propose that pedagogical knowledge is greater than pedagogy, since it implies academic-pedagogical training, training or teaching experiences, experiences in the field of work, and conceptions about life and education.

In contrast, Cárdenas et al. (2012) propose that pedagogical knowledge is the object of study of pedagogy; Pérez & Fonseca (2011) take up again Eloísa Vasco's thought on reflective praxis to go beyond the instrumental transmissive and understand it. Pérez, Sánchez and Alfonzo (2009) take a very positive stance which, unlike the vast majority of the authors referred to, excludes everyday life from the process of building pedagogical knowledge. Finally, Prieto (2012) proposes the transition from an informative and professionalizing teaching practice to a formative and investigative one. The previous authors develop the concept of reflective praxis as a path in training and teaching.

The epistemological references of the complex thought proposed by Morin (1994; 1999) present premises or principles of systemic, hologrammatic, dialogic, self-generative character, of uncertainty and of inclusion of the researcher, which will be the basis to interpret the findings obtained in the study and to allow the construction of pedagogic knowledge in the framework of such paradigm.



Finally, the references that support narrative design, where Botero, Hincapié, Salazar, Pico, and Mejía (2006), Daiute et al. (2007), Daiute and Lightfoot (2004), Ospina and Botero (2007) are proposed as references to understand the role of hermeneutics in Dilthey's thought that had already been implemented in other narrative design research with a proposal for interpretive understanding, as for example in García and Salazar (2016).

## Methodology

In order to achieve the proposed intention, research was conducted with a qualitative approach, applying an interpretative design using a narrative method. The participants were fifteen volunteer teachers from Santo Tomás University - Bucaramanga, with whom a semi-structured interview was carried out to systematize narratives on the implementation of actions and teaching strategies that would favor the design, application and evaluation of the training processes carried out between the second semester of 2017 and the first semester of 2018.

The research strategy allowed the construction of pedagogical knowledge based on the recognition and reflection of the pedagogy and didactics used out by a group of teachers from Santo Tomás University - Bucaramanga. The information was systematized, classified, codified, related and interpreted with the help of the qualitative analysis software Atlas.ti. The findings from the interpretation of semi-structured and videotaped interviews with the fifteen teachers allowed for the interpretation of relationships and interactions according to the narrative model proposed.

## Results

Following Sampieri et al., (2014), the process of interpreting interviews and teaching narratives was developed in the following steps: Exploration of the systematized information; organization structured in units of analysis and

codes; description and interpretation of findings and patterns and their relationships, in order to construct the meaning for the actors, interpret it and explain it according to the approach of the problem; in-depth understanding of the context surrounding the information and data obtained; and, relationship of the results with the state of the art and the theoretical framework.

Taking into account the above, the following aspects that converged in a significant and recurrent way during the development of the interpretative process are highlighted:

The role of the researcher, not only in the obvious interaction with the participants, but in the reflective process that occurred as a product of the interactive loop in the research. This aspect was identified at the time of reviewing the interviews, allowing for the recognition of the active role of the researcher, not only as a reader of realities, phenomena and interactions, but also as a teaching peer, counselor and facilitator of the process of reflection on teaching practices within the framework of a pedagogical research process.

The process of qualitative understanding of the data did not take place in a linear manner, but rather it was developed taking into account an ecological or contextual view, treating and understanding each data by what it expresses in itself and by its relationship with others, that is, in its complex dimension. The selected data segments, quotations or units of analysis were classified in a category system, as proposed by the tradition in the qualitative approach (Ritchie, Lewis, Nicholls & Ormston, 2013; Li & Seale, 2007, referred to in Sampieri et al., 2014. pp. 418-419). The above was supported by Atlas.ti software to facilitate information analysis and output of textual and graphic reports for a process of knowledge interpretation and building from the organization, categorization, relationship, understanding and conceptualization based on such information.

The results correspond to the description and interpretation made by the researcher, from the material recorded and systematized with the support of Atlas.ti under the name of MEP (problem-based educational model), which was being revised in each of its documents to be described, classified or interpreted. The identification of units of analysis, segments or citations was free flow, that is, the units do not have an equivalent size, but depend on each subject or group in their own context of meaning.

In this first level of analysis, the categories and codes identified were related to the data they represent, making the linkage evident and this can be seen in the code lists provided by the Atlas.ti software. An important aspect of the systematization process with the software lies in

the assignment of codes to those units of analysis or segments that share nature, meaning and characteristics. Thus, the initial work consisted of identifying and coding the units of analysis of the fifteen interviews with teachers, and then identifying the categories of analysis: teaching practices and reflections, and then proceed, in a third moment, to construct pedagogical knowledge of the complexity paradigm.

Table number 1 presents in a descriptive and quantitative way the number of quotations or units of meaning that will be analyzed and interpreted to describe and characterize the narratives about the pedagogical and didactic practices of a group of teachers at the Santo Tomás University - Bucaramanga to build pedagogical knowledge in the light of the principles of complexity.

Table 1. *Categories, subcategories, density-number of citations to be analyzed, percentage*

| Categories  | Subcategory                                     | Analysis Unit | %      | Total | %    |
|-------------|---|---------------|--------|-------|------|
| Strategies  | ABP   | 5             | 11,36% | 44    | 34%  |
|             | Integrating project                             | 5             | 11,36% |       |      |
|             | Workshops and collaborative groups              | 4             | 9,09%  |       |      |
|             | Practice and use of laboratories                | 5             | 11,36% |       |      |
|             | Use of ICT                                      | 16            | 36,36% |       |      |
|             | Classroom research                              | 4             | 9,09%  |       |      |
|             | Use and production of support material          | 5             | 11,36% |       |      |
| Reflections | Institutional Pedagogical Educational Model     |               |        | 86    | 66%  |
|             | Representations and conceptions (8;9%)          | 19            | 22,09% |       |      |
|             | Application of the model (8;9%)                 |               |        |       |      |
|             | MEP training (3;3%)                             |               |        |       |      |
|             | Academic performance and teaching accompaniment | 5             | 5,81%  |       |      |
|             | Evaluation                                      | 24            | 27,91% |       |      |
|             | Class planning                                  | 20            | 23,26% |       |      |
|             | Interdisciplinary                               | 3             | 3,49%  |       |      |
|             | Teacher Training                                | 3             | 3,49%  |       |      |
|             | Strength  | 6             | 6,98%  |       |      |
| Weaknesses  | 6   | 6,98%         |        |       |      |
|             |   | 130           |        | 130   | 100% |

Source: Research.



Thanks to an identified and subsequent classification, some major strategies containing specific didactic actions are highlighted, as follows:

- Project based learning
- Integrating project
- Workshops and collaborative groups
- Practice and use of laboratories
- Use of ICT
- Classroom research
- Use and production of support material

In addition to these six strategies or didactic actions, other categories that emerge during the comprehension of narratives and that were taken into account as transversal processes to the identified strategies and are part of the reflections of teachers, are referred to below:

- Planning
- Evaluation
- Interdisciplinary

The description above identifies and categorizes the teaching practices of the group of research participants; although the information cannot be transposed, it is presented as a reference for comparison and research work.

The knowledge evident in teachers' narratives about their practices is the product of a reflective exercise in relation to the questioning of how to teach. In this way, the participants shared and allowed for the systematization of their practices and reflections to carry out an interpretative description of their pedagogical practices, as proposed by Zuluaga (2006), Almonacid et al. (2014), and González and Sánchez (2016).

The pedagogical and didactic knowledge presented below is typical of a narrative construction of teachers, which is interpreted and required, from both teachers and researchers, an action of identification and active reflection on their own educational, pedagogical and didactic practice from the time of the interview itself until the application of the particular interpretative method. Gonzales & Ospina (2013) and Pérez et al. (2009) call this the premeditated and conscious action of reflecting on the action, which allowed for the identification and description of the different didactic actions and pedagogical strategies of the teachers and their reference, in what was called pedagogical and didactic narratives. As described by Ospina and Botero (2007), narratives are a vehicle for the understanding of the world of life, of the discourses, values and subjectivities characteristic of the symbolic reality of teachers, that is, the teachers' narratives about their practices.

Through the pedagogical narratives of teachers, we reflected about strengths, weaknesses and possibilities of continuous improvement in search of the training of the students, serving as a method through which the meanings of the teaching practices were found. At the same time, it allowed for the direct understanding of the pedagogical and didactic practices of the teachers from an epistemological perspective (Dilthey, quoted in Botero, Salazar, Torres M, & Pico, 2006)

This pedagogical and didactic knowledge built by teachers thanks to reflective praxis, involves a complex fabric that integrates various aspects (pedagogical, didactic, disciplinary, practical, ethical), which, in the form of a recursive loop, increasingly enriches teaching practice, integrating them into a uni-dual understanding (Morin, 1994), that is, mixing all the multiplicities in a complex construction. It is then considered that the knowledge built upon teaching practices is in itself complex and that, in order to achieve this, a change of

focus is necessary in regard to education and its exercise, orienting it toward a more humane vision in a universal context (Morin, 1991).

In this way, when teachers reflect on their practice and the results they achieve, they show clear transformations in their practical exercise, achieving richness in expressions, diversity in applications, innovation and adjustments in activities and didactic sequences, ratifying what was proposed by Zuluaga (2006) and Ibáñez in Almonacid et al. (2014).

This transformation is possible, as stated by Gonzales and Ospina (2013), Pérez et al. (2009) and Prieto (2012), if teachers promote and implement a reflective praxis, making continuous criticisms and improvements to their teaching practice, for which personal work is necessary, not only to learn techniques or strategies, but to commit to the systematization and reflection of their own practices in order to evaluate, improve or change them, moving forward, transforming their exercise from an informative and professionalizing praxis to a formative-investigative praxis (Prieto, 2012).

The interpretation of findings allowed for the meaning and construction of pedagogical and didactic knowledge, placing the teacher as the agent of such knowledge (González and Sánchez, 2016; Díaz, 2016; Tardif, 2004, Latorre, 2004 and Mena Remognoli (cited by Cárdenas et al. 2012)). However, unlike the latter, and according to Zuluaga (2006) and Almonacid et al. (2014), the result of this research shows that pedagogical knowledge does not consist of privileging theoretical or applied knowledge of pedagogy, but rather recognizing, in a complex manner, the interrelationship of the reflections and conceptualizations that teachers make about their own actions, advancing in what is proposed as a complex educational praxis that differs from a merely isolated knowledge about working inside the classroom, in order to be in a scenario where

reflections and conceptualizations are derived, situated, contextualized and interrelated from pedagogical, multidisciplinary, subjective and intersubjective knowledge, which characterize its levels of complexity.

Thus, the research showed that teachers have different pedagogical knowledge, that is, different conceptions about the way to carry out the teaching processes, which have been acquired throughout personal, professional and teaching life (whether short or long), as proposed by Almonacid et al. (2014), González and Sánchez (2016), Díaz (2006) and Cárdenas et al. (2012). These reflections are interwoven and particularize the multiple and different beliefs and practices of teachers, constituting pedagogical and didactic knowledge about teaching practices in the context of USTA Bucaramanga.

### **Characterization and Pedagogical Knowledge on Teaching Strategies of University Teachers**

The integration of the pedagogical knowledge achieved from teachers' reflections in each of the strategies or didactic actions identified is presented below:

#### **Project Based Learning**

This strategy requires planning that integrates class work and independent work as well as progress reports and final presentations establishing formative agreements from the beginning with clear evaluation criteria, a process in which the teacher gives feedback to students showing their progress in relation to the learning results, the competences to be developed, the purpose of the course and the expected professional profile, as well as the characteristics of the students and groups. The strategy allows students to impact contextual or community scenarios and spaces by transferring knowledge to the community through awareness and information processes.

### ***Integrating Project***

It is a complex strategy that, in an articulated way, is presented, on the one hand, as a pedagogical resource focused on practical learning in context or in laboratories with simulation tests and real implementations and, on the other hand, as a strategy of visibility and articulation with the external environment and, finally, as an evaluation strategy

### **Workshops and Collaboration Groups**

Collaborative work strategies developed through workshops in pairs or alternating individual and group collaborative work favor the development of individual and collective capacities. In some cases, they are integrated with learning strategies based on challenges, problems, cases or questions. During these activities, the group works as a whole and students learn in a constant and reciprocal exchange, generating reflective and comparative dialogs that allow for the development of knowledge and skills for teamwork, autonomy and interdependence.

### **Laboratory Use and Practices**

These practices and learning strategies favor the concrete application of reflected knowledge, allowing students to grasp the concept. However, this clarity seems to indicate that, although the need for integration and complementarity between theory and practice is recognized, it continues to be oriented separately without interrelating the two moments according to the purpose of learning.

In order to promote the integrality and complementarity of this type of apparently antagonistic knowledge, a model that tends towards complexity is indispensable, which conceives that both conceptual and procedural knowledge are necessary and complementary for knowledge or the achievement of a specific performance, which requires waiting for the separation between theoretical or conceptual knowledge and practical or applied knowledge, approaching the notion of integral and complex performance. Thus, innovative strategies emerge that allow for a vision that, while maintaining a linear procedural view, proposes a transition toward a networked curriculum that poses a complex relational articulation of subjects and knowledge among themselves.



## Use of ICT

It is important to clarify that the results of this research are interpreted at a time prior to the Covid-19 pandemic, although it is true that, after this situation, the educational contexts were oriented to go to the mediated contexts, we intend to understand these results to make a reading on the implementation of ICT by teachers in this institution.

The number of strategies that integrate information and communication technologies reported by teachers (derived from interviews) is quite small; this, in one way or another, suggests that, although the implementation exists, in many cases the level of use is still limited.

The interaction of students with technical and technological resources for work in their professional field has been taking place and must be done in ever greater depth in the

different processes and levels of training and educational interaction, which is why it is necessary to advance in the training of teachers in this field, as well as in the construction of accompaniment processes to re-dimension the inclusion of technological and pedagogical tools in the training processes. However, this process must be articulated to the intentions of each program; therefore, the use of software must have the support, guidance and accompaniment of teachers to encourage and complement the development of knowledge and learning by students, so that the pedagogical and didactic knowledge of the teacher is decisive.

The ICT resources and tools used are listed below in a proposed classification according to their level of use in communicative, expository, VLOs (virtual learning objects) and VLEs (virtual learning environments), use of online resources and specialized student-software (see Table 2).

Table 2. *Classification of ICT Resources and Tools Used*

| Communicative   | Expository   | Interaction with online resources  | VLOs and VLEs                   | Use of resources and specialized software  |
|---|--|--|---------------------------------|--|
| Email<br>Email groups<br>WhatsApp groups<br>Office Suite<br>Institutional emailing platform | Presentations<br>Slideshows<br>Explanatory or documentary videos<br>Videos of topic specialists<br>Movies<br>combined with bibliographic resources | Bibliography search engines<br>Websites<br>Blogs<br>Kahoot<br>Educrayon<br>Go-anime<br>Pusshi<br>Free online resources<br>WhatsApp as a collaborative learning environment<br>Office 360° Suite<br>Institutional resources | Institutional virtual classroom | Architectural Design Programs - ARCHI-CAD<br>MATLAB-Simulations<br>Genetic Algorithms<br>Neural Networks |

Source: Research.

Table 2 shows the levels of understanding and use described by teachers as follows:

**Communicative:** This category includes the use of email, group mail, WhatsApp groups, Office Suite, institutional email platform. As it can be seen, it is a primary level that consists of a more informative, communicative and transmissive position.

**Expository:** Presentations, slideshows, explanatory or documentary videos, videos of topic specialists. movies combined with bibliographic resources which contribute to present situations, cases or concrete aspects in the classroom.

**Interaction with online resources:** This category includes the use of bibliography search engines, websites, blogs, Kahoot, Educrayon, Go-anime, Pusshi, free online resources, WhatsApp as a collaborative learning environment, Office 360° Suite and institutional resources. These resources propose interactive or Web 2.0 elements that allow interaction between students, students and teacher and between students and content.

**VLOs and VLEs:** where the development of the objects that are housed in the virtual environments of the courses is included.

**Use of resources and specialized software:** we included the Architectural Design Programs –ARCHICAD, MATLAB- simulations, genetic algorithms, neural networks, which are used for the interaction of students with actions typical of the professional profile in training. These types of resources require more planning, development and follow-up.

In this context, it is necessary to give continuity to the work that teachers have been doing in terms of incorporating ICTs into classrooms and educational ecosystems. These elements are related to the recognition and use of institutional resources and possibilities, as well as of online free resources.

These elements become important not only to diversify the techniques or didactic strategies, but also to become mediations that, in the current times of the Covid-19 pandemic, become an inevitable reality and must be faced, above all, with teacher training processes, both in the technological and in the pedagogical use of these resources, integrating the communicative, interactive, collaborative, and research promotion dimensions as a path within the framework of the educational pedagogical model and the institutional guidelines for the creation of virtual educational material.

Thus, it is important to mention that, in a complex manner, different levels of development and understanding by teachers coexist at the time of research, but simultaneously, a certain level of ignorance and distrust of virtual processes, making this a subject of interest that emerges as research interest in different areas and dimensions.

While it is true that technology in the classroom has generated notable changes and new learning environments, among which games manage to capture the attention of many users, generate commitment and better learning outcomes (Zabala-Vargas, Ardila-Segovia, García-Mora & De Benito-Crosetti, 2020), technology alone cannot replace the pedagogical component, it complements it. This is why the field of teaching narrative on the implementation of ICTs becomes a relevant and necessary scenario in the framework of technology-mediated education.

### **Classroom Research**

The research strategy in the classroom allows the student to face a problem or problem situation and to propose a solution to it. The teacher offers material for the construction of that response and asks to investigate more about cases like the one presented. In some cases, a work guide is given to students.

## Use and Production of Educational Support Materials

In their teaching practice, teachers make use of various support resources and textual and audiovisual materials available in different media and repositories –that may be external, their own or institutional. The use of different strategies and resources is part of one of the elements of the complex learning ecosystem. As such, it is decisive in the understanding of its dynamics and contributes to the communicative and active character of the learning process, through which teachers propose learning scenarios to students, either from more transmissive-informative positions or from more active and constructive ones that see in the teaching strategies a resource and the way to bring an enriching experience to students, through which they achieve the proposed learning results.

To conclude this section, it is considered necessary to emphasize that the systematization and research on the teaching and learning experience allows for the documentation of actions, the recognition of aspects related to the design, execution and evaluation of the exercise itself, the scope of the training purposes, the articulation with the MEP and the training plan of the curriculum in an integrated manner, the conceptions of the subject, of learning and teaching that underlie the exercise, the mastery of the methodologies proposed and put into practice. All of the above corresponds to a teaching action committed to its professional practice and social responsibility. This process is called reflective praxis (Prieto, 2012; Vasco in Pérez & Fonseca, 2011; Pérez & Fonseca, 2011; Gonzales & Ospina, 2013 and Pérez et al. 2009), and allows for the transformation and change of both the subjects that interact in the educational complex, in the dynamics that they establish and in the construction of knowledge that is available for the construction of proposals and solutions to contextual and global needs.

Thus, the reflective praxis, manifested in the will of continuity both in teaching and administration, in the reflection and continuous improvement of the strategies and didactic actions, works as a circuit that allows the exit, or the recognition of a situation and reflection on it, to take action and improvement plans that, in the best form of a feedback loop, helps the process to be adjusted thanks to the feedback of the process itself, which allows for continuity and relevance, becoming differentiating factors that promote and favor the integral formation of students, in the institutional perspective.

The actions that went beyond the continuous improvement of the same strategy and proposed actions that, thanks to that circular feedback (feedback loop), allowed for didactic innovation, or subjective or intersubjective transformation, constitute, in another level of complexity, the recursive loops (Morin, 2001 p.215-295), that help to show the self-productive capacity of human action in the learning environment, be it face-to-face or virtual.

## Complex pedagogical and didactic knowledge resulting from the interpretation of the teaching stories about their own practice

Below, we present the knowledge achieved in each of the proposed and emerging categories that allow us to corroborate the thesis that it is possible to build pedagogical and didactic knowledge from complexity based on the identification and reflective understanding of the teachers' narratives on teaching.

### Knowledge about lesson planning

The planning process allows for the generation or design of the conditions of the learning experience available to the student or group of students (see the strategies and didactic actions referred to in the first section). The development of the planned actions is a determining aspect, but it imposes the need

to have clarity about the competences or knowledge to be developed in the students, in such a way that, in the development of the teaching process, feedback loops can be proceeded at the level of the subjects of the educational act (micro-curricular), of the program curriculum (meso-curricular), and of the institution (macro-curricular), impacting different levels of the learning ecosystem.

Starting from what the student knows and has in his or her daily life is strategically decisive, taking into account personal and then professional aspects, and recognizing the role of subjectivity and objectivity in research and in the construction of arguments that allow progress to be made towards complex positions in education.

Although teachers reflect on the planning exercise, some prefer to remain in the plan developed traditionally, maintaining a state of balance that, in some way, stays away from change maintaining traditional and transmissionist strategies and didactic actions. In contrast, from the perspective of complexity, the educational act is understood as a complex network of situations and interests situated in a situational historical context, where there are dialogical interactions between the different elements (subjects and objects) that make it up, generating actions and retractions (retroactive loops), which give the complex system of education its complex character, that is, the recognition that the actions of the teacher or the subject are the self-propulsive engine.

This autonomous, self-generative character filters the phenomena that mobilize it within the framework of a dialogical interaction of interdependence. Thus, many times the dynamics of learning ecosystems reach only self-organization, achieving a minimum level in which endogenous learning is attained, while, in contrast, other ecosystems establish a dynamic of interdependence with the environment and an interdependence with the context is

generated, allowing to find both problems and answers in the context outside the classroom. At another level is the reorganization of the learning system, when the ecosystem and the subjects are transformed, change in their disposition to learn, to interact with themselves and with others in a broad context and with purposes of common benefit which generates a social metamorphosis from an educational metamorphosis.

The action of reflecting on one's own practice, on its planning and development, allows for the emergence, simultaneously, of a retroactive loop in the pedagogical practice and this helps teachers transform their strategies and didactic actions into a permanent process of reflection and action that favors the constant development of the educational act and that, in other cases, transforms the elements of the context of educational interaction in the form of a recursive loop generating valuable innovations in the teaching process.

The above suggests the importance of giving time and resources to the teacher to become familiar with the course he or she is guiding, to test specific teaching strategies and actions, through which, disciplinary knowledge as well as knowledge about teaching is ratified or advanced. In other words, the teacher develops knowledge about teachability as a meta-knowledge or knowledge of a different and emerging level of complexity that, little by little, becomes knowledge about the specific didactics of the disciplines.

The planning process is carried out based on the experiences and reflections on them; these reflections on the practice itself achieve transformations and improvements. However, there are also teachers who do not manage to carry out these reflective exercises and who find themselves in front of the teaching practice without carrying out the action that Loredó et al. (2008) call reflective praxis, and, although they recognize some elements of the Educational

Pedagogical Model, they do not necessarily understand its conception or application. This highlights the need to continue recognizing institutional references through induction, re-induction or training courses.

The knowledge about the Problem-based Educational Model supports the didactic planning of teachers, who are based on the development of the moments of Seeing, Judging and Acting, and translate it into actions and strategies prepared for the achievement of learning. Some of these maintain characteristics of traditional models and practices, while others are hybrid, incorporating active and participatory strategies and actions focused on the development of competencies from the dimensions of human action, migrating to new ways of structuring the educational and training processes.

In the planning process, the teacher proposes a didactic device that allows the student to develop an experience, which, in most cases, promotes and favors the learning proposed for the course; in this way, every action and didactic enrichment process should bear in mind the following:

- The student's exit profile in the different programs, the learning results and competences to consider, the didactic and evaluative strategies, their coherence and articulation (Shulman, 1989).
- The assertive handling of the technical, logistical, and interaction difficulties that arise for the development of the course (De Lella, 1999).
- A permanent process of tracking experiences in other training processes related to the educational context in different modalities, in national and international scenarios.

- The permanent review of the planning and development of the course in order to contrast and make adjustments required to achieve the training purposes (Shulman, 1989).

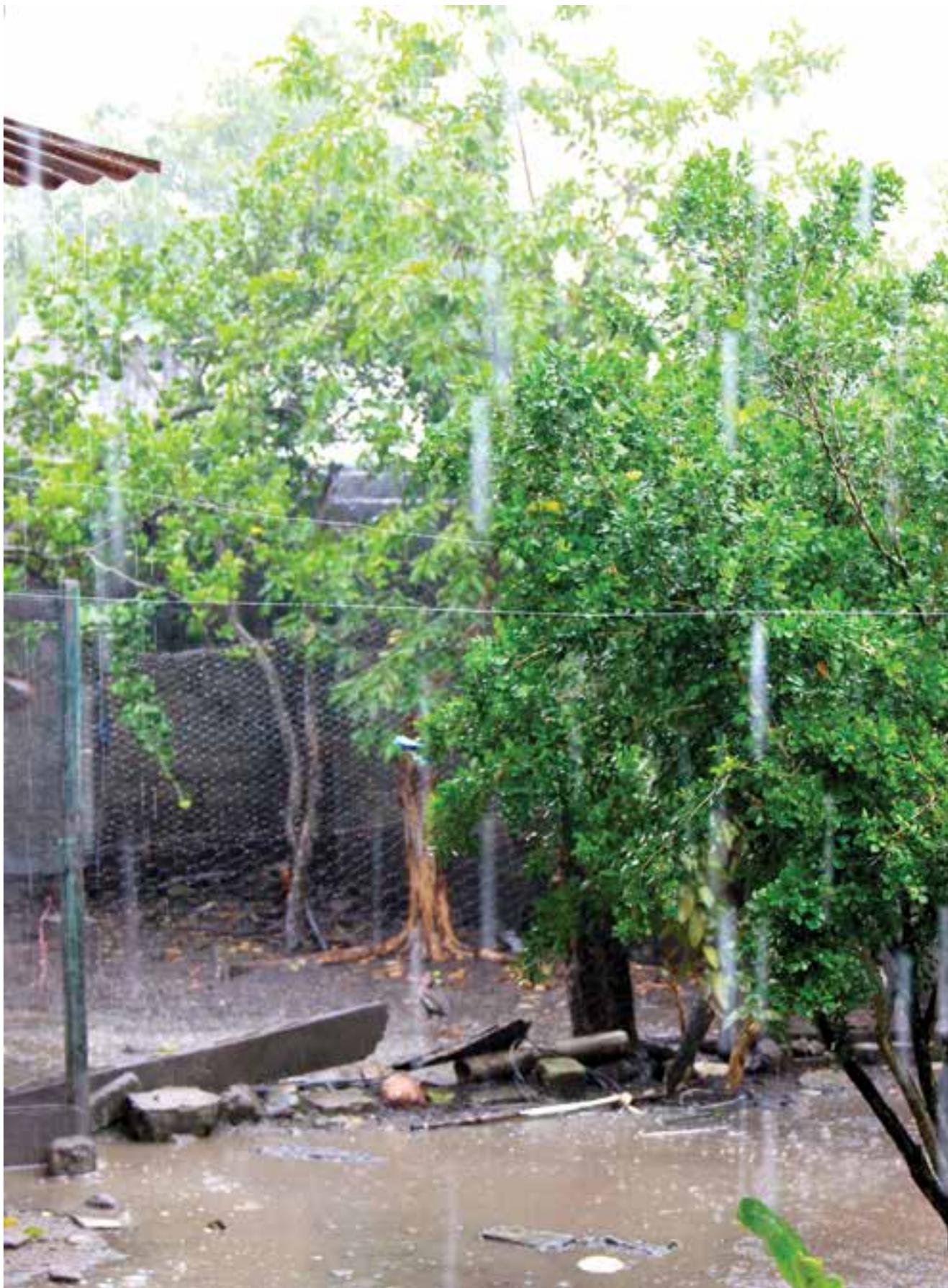
The support and institutional accompaniment that can be given to these actions makes it possible for the planning of the course and the development of the training proposal to be coherent, at the macro and meso curricular level, with the goals of the institution and the academic program respectively, and at the micro-curricular level, with the training purposes and disciplinary knowledge to be developed with the different students in each course.

Therefore, it is necessary that teachers develop conceptual, procedural and motivational knowledge that, when combined, allow for a practical-reflective process that leads to the permanent improvement of the suitability, pertinence and coherence of their teaching practice.

Thus, in the search for this permanent transformation of training and for suitable strategies, teachers carry out their planning processes, coherently with what is proposed by (García, Loredó & Carranza, 2008), taking into account the very characteristics of diverse knowledge, the resources available in the institutions derived from the condition of technological and economic development of the country and of the organizations and the characteristics of the learners they meet in each new academic period.

### **Teaching knowledge about the MEP (Problem-based Educational Model) of Santo Tomás University – Bucaramanga**

This section is divided into three parts: representations and conceptions, implementation and training in the educational pedagogical model:



### ***Representations and conceptions about the MEP (Problem-based Educational Model).***

Teachers' narratives allow us to conclude that upon entering USTA, the approach and orientation on the MEP proposed by the institution as a reference for the training processes begins. Later, in the academic or administrative work, teachers approach the institutional pedagogical concept (meso-system) allowing for familiarization and different levels of understanding and application (micro-system).

In this context, teachers associate students' search for the development of critical thinking to the model proposed by the university, to the development of integrity and a human and social conscience of the environment. Likewise, teachers recognize and associate the MEP with the institutional humanist vision, connecting this aspect as part of the integral formation proper to the Institutional Educational Project, this being the greatest association of teachers with their training work.

Although the problem model aims to provide solutions to the needs of the environment based on the disciplinary knowledge of Santo Tomás University defined as an institution of general studies, a problem-based process is not always evident. The above suggests the need to continue working not only on making the MEP known but also on reflecting on its implementation and development in the USTA context.

### ***Teachers' knowledge about the implementation of the MEP (Problem-based Educational Model).***

The process of application of the MEP by teachers is related to their understanding of it and the oriented reflection they achieve when they implement it, generating the articulation of their practices and new training schemes, that is, with the exercise of reflective praxis, (García, Loredo & Carranza, 2008; Prieto, 2012).

The didactic process that is favored and developed through the steps of the MEP: See-Judge-Act are expressed in a concrete way in the class session, generating the conditions and means for the achievement of the course objectives as a central element of the learning process. Thus, the implementation of the MEP is carried out in various ways, demonstrating the rhizosphere or loop expression of self-regulation and didactic innovation (self-regulatory and generative loops).

Teachers state that the educational purpose of the MEP is that students carry out an analysis of reality and, based on a problem, begin to build solutions. From this perspective, the disciplinary knowledge constitutes a tool for the solution of problems and only when it is applied to the contribution or the resolution of a problem assumed as a valid and pertinent knowledge that transcends the taxonomy of the disciplines to be located in a multidisciplinary framework that moves towards the construction of trans-disciplinarity.

### ***Knowledge about Training in the MEP.***

In the training processes developed by the institution within the framework of the teacher training plan, guidance is given on the principles and institutional philosophy, the role of the teacher within the framework of the MEP in each curriculum. In this way, and as a policy, the institution requires teachers to be trained in the different courses offered by the UDCFD Curriculum Development and Teacher Training Unit, in order to be updated in the educational model. This is one of the ways in which the teacher knows the institutional references of integral formation from the philosophy and institutional understanding. Thus, diploma courses are a way to gain knowledge of the MEP, the expected role of the teacher, the conception of the educational function, and the curricular management related to the planning and construction of syllabus from the problem-based model. It is therefore necessary

to reinforce the process of understanding and didactic innovation in the implementation of the MEP, through the generation of spaces such as diploma courses and pedagogical laboratories for teacher training that emerge as a proposal within the framework of research (García 2020).

### ***Knowledge about Teacher Training within the Institutional Plan Framework***

The importance of disciplinary, pedagogical and didactic training is presented in the reflections made by the teachers. They recognize and give great value to the contribution generated by the courses of the institution's teacher training plan. The promotion of the development of both pedagogical and disciplinary knowledge is fundamental to the training plan of the institution, which appears as a great contribution to the academic life of teachers.

In this way, institutional training corresponds to a process generated by the organization itself that fulfills orientation and regulation functions as a retroactive organizational loop. This allows us to move towards the generation of recursive loops or innovative and transforming actions in the context of institutional pedagogical thinking.

### ***Teachers' knowledge about the academic performance of students and the accompaniment of learning by the teacher.***

In accordance with the principle of uncertainty proposed by Morin (1975: 98-101), academic performance is always variable in groups of students, and is expressed in the achievement of competencies from the dimensions of human action, that is, when students solve concrete problems and can do so more quickly and better. Nevertheless, individual work continues to be conceived as fundamental. Therefore, following up on the work of each student makes it possible to give an account of the development of his or her competencies and of his or her demonstrated ability in a particular field.

In this scenario, the development of a communicative environment that allows for the clarification of work commitments and thus to enter into the described training process of advice and guidance is decisive. In accordance with the dialogical principle proposed by Edgar Morin, the relationship established between teacher and student as members of a learning system constitutes a factor that makes the system and its elements more dynamic, imprinting a particular dynamic according to the level of subjects that make up the system, their capacities for interaction and cooperative work towards a common objective. In this case, this objective is learning and the construction of disciplinary knowledge.

As part of the process of accompanying academic performance, teachers use each of the class activities as a training process, for example, the process of final work presentation. Although the teacher remains central to the development of the course, the active role of the student is necessary and fundamental, otherwise the dialogical work is not established.

The role of the teacher is to generate contexts and experiences that allow the student to build bridges between the different knowledge of science and everyday life. This is done in search of a multidisciplinary complexity that places them in a new way of understanding knowledge, science and life. In this search, the teacher maintains an attitude that transcends the transmission of a unifying model, for a much more integrative and reflective position in search of the transformation of teaching practices.

### ***Teachers' knowledge about the process of assessment of human development and learning.***

Teachers consider that it is important to establish an environment of communication with students in order to favor participation processes and promote dialogical exchange that ratifies and leads to more learning in a retroactive and generative way.

The role of the teacher requires decision-making in the classroom aimed at developing processes of generative dialogue and interaction with students, in face-to-face or virtual contexts, which, more than judging, qualifying or assessing, allows the student to understand and get feedback on his or her learning process. The above will allow us to move towards a perspective of the assessment goal or evaluation of the assessment, in which the person, through the analysis of his/her performance and learning results, assumes a reflexive position on his/her processes of construction of knowledge, commitment and responsibility.

### ***Complexity in the narrative construction of pedagogical and didactic knowledge.***

The pedagogical knowledge achieved cannot be interpreted in isolation; it must be understood as a networked emergency that shapes knowledge about knowledge, that is, meta-knowledge. This meta-knowledge has to do with the recognition and reflection of the interactions, retractions and uncertainties generated before, during and after the work in the educational environment, a process that seeks to integrate the different knowledge and actions understood in an analytical way looking for the totality and its integration in a plexus of pedagogical knowledge.

The understanding and construction of pedagogical and didactic knowledge based on teaching narratives must be carried out from a complex perspective, taking into account that educational action is found in an ecosystem characterized by some elements. These establish particular and specific relationships generating a totality, a complex identity that contextualizes each learning scenario.

The systemic principle to which Edgar Morín refers allows us to understand the educational act as an ecosystem where the subjects of learning (the student, the teacher), the contents or disciplinary knowledge, the resources and

didactic mediations, the institutional purposes, the needs of the context and the educational policies interact, forming a complex ecosystem of learning environment in which specific experiences and knowledge are generated.

An important aspect of the systemic principle is the possibility of understanding educational action as an interactive, complex, ecological, relational networked process, which makes it possible to identify its elements and intentions.

The analysis of the teaching practice, its planning, development and evaluation, allowed the construction of knowledge product of the teaching reflection on his/her own exercise. This knowledge that emerges from reflection is in itself a regulating and generative loop, taking into account that it seeks the construction and development of a specific didactic knowledge that is put into practice in an iterative and reiterative way, generating and transforming itself and acquiring value as situated didactic and pedagogical knowledge. These reflections allow the conceptions about teaching, learning, subjects and the interactions between them to become dynamic and permanently recreated.

Pedagogical knowledge is generated in non-linear reflexive loops, which go from actions to planning and again to their execution in such a way that the old and the new are permanently combined in a didactic, pedagogical and educational metamorphosis. The research generates a loop through the narrative design, the results allow to generate another retroactive loop that, from the uncertainty, is expected to generate transformations and metamorphosis.

The hologrammatic principle helps us understand that the elements described above are integrated in an interdependent way and into the daily practice of the learning system generating communicative patterns and beliefs that coexist in the subjects of learning and in their interactions, generating an aspect of cohesion between the elements



of the learning system. It is, moreover, an interrelationship so important that gives meaning to the teaching-learning process and thus everything that happens in and out of the classroom carries with it the meaning and purpose of the learning ecosystem.

The dialogical principle is crucial to the understanding of the dynamics of the learning ecosystem. Thanks to it we can integrate processes, intentionalities and apparently antagonistic and opposite results. In this way, the dialogical principle helps us understand that the dynamics of learning ecosystems are not linear and, on the contrary, invites us to understand the patterns and organization that may occur in an apparently disorganized state. This principle allows us to see the rupture with the linearity of behavioral models of stimulus-response in order to situate ourselves in models that even transcend the individual construction of the subject to position ourselves in scenarios of collaborative work, both face-to-face and virtual.

The principle of self-organization alludes to the capacity of systems to organize themselves as a permanent and generative tendency that guides the general behavior of the system based on the interactions among their members and between them and their context (recursive loop). In the process of interaction of the ecosystem, retroactive loops are generated which propose, in a permanent way, self-regulation actions both for the teacher in the teaching process and for the student in the learning process. These retroactive loops, self-regulatory actions or continuous improvement are necessary for the improvement of training actions and learning processes. Retroactive loops fulfill a self-regulatory function in the educational process. Therefore, the process of feedback and accompaniment to learning provided by the teacher is a determining factor in both motivation and performance and in the quality of the learning results achieved.

This process of retroactive interaction allows the student to retrace or return to adjust his/her knowledge structure and the learning process itself; but it also allows the teacher to identify which aspects of the pedagogical knowledge or specific knowledge should be strengthened or integrated. In this way, the retroactive loop influences simultaneously but differently each of the subjects of the educational act and can also be considered at the level of the course, the program and the institution by increasing the level of complexity.

This feedback loop or feedback function that the teacher performs must go beyond mere indication and instruction or checking of faults to become a collaborative work that generates enrichment experiences to achieve the proposed learning goals. It should be noted that these feedback loops are the basis of the transformation and learning processes. However, they represent a first level of complexity that is necessary, but not sufficient to become a generative process or a recursive or second order loop, in which the actions of the teacher and the student generate transformations that change the knowledge structures of the learning subjects in such a way that they produce a new organization generating a new level of complexity. This is how innovation and transformation are only achieved from the action-reflection-action loop of educational practice by teacher themselves. In this way, the role of the didactic strategies proposed by the teacher is to generate tensions, imbalances and disturbances that favor dissipation or self-organizing (retroactive) or self-poetic (recursive) loops.

The results allow us to see and interpret that, for the teachers interviewed, the notion of uncertainty is not taken into account in planning processes, which continue to be linear and do not bear in mind the particularities that arise during the development of the teaching and learning process which, even if not planned, may be determining emergencies in

the process itself. Thus, planning in uncertainty requires a change of conception that goes from the linear to the spiral and that must be put into actions and strategies.

The principle of reintroducing the knowing subject into the process of knowledge is necessary to avoid certain blindness and certainties. The process of narrative interpretation proposed and implemented constitutes a methodological and epistemological element since it allows the consideration of the interpretations made by the researcher and by the subjects themselves, as well as the reconstruction of the pedagogical and didactic knowledge achieved. The understanding of complex learning ecosystems is the product of the pedagogical knowledge reached in the research.

## Conclusions

The findings are not isolated results; they are part of a relational network that is being woven around the knowledge of teachers about their own practice, consolidating a practical-reflexive plexus that is fundamental for a better understanding of their role, for the construction of specific didactic knowledge in their disciplinary field, for the self-regulated improvement of this exercise and for the emergence of innovation in it.

The most relevant findings are oriented to the recognition of reflective praxis as a resource to promote the development of a regulatory and generative loop that contributes to the transformation of educational action by proposing the research of educational action as a didactic strategy, articulated to a narrative production approach.

Institutions, understood as a complex system, generate plans for teacher improvement, curriculum review and adjustment processes consolidated as regulatory loops within the system or institutional learning context. Although these processes are necessary and their results and impact are evident, it is

necessary to take them to a level of reflection and practice that allows for permanent recursion that gives way to the permanent improvement of processes, to the construction of situated didactic knowledge, and to the possibility of innovation oriented to comprehensive, complex training that moves from disciplinary to multi-disciplinary.

There is a search for certainties and they remain blind in the process of building knowledge, and obviously in the process of teaching it. That is why it is necessary to consider planning as a recursive loop, from a view of positive uncertainty in such a way as to promote integral formation. In this way, planning should be considered as a meta-knowledge that it is necessary to collect, interpret and reinterpret in the process of building disciplinary didactics.

The process of evaluation and teacher accompaniment of student learning are self-regulating loops that aim to consolidate disciplinary learning and use it to solve different problems by the student. In this way, the evaluation and the dialogical function of the teaching accompaniment is to favor the loops as a didactic device in its regulatory and generative functions. This will lead to the generation of a path towards the metamorphosis or transformation of the educational action. These processes that function as a loop –teacher training, planning, evaluation- become a loop of organizations that allows loops at another level, that is, a meta-loop or a loop that allows a second level of understanding and action.

It is concluded that pedagogical knowledge is the result of the reflective processes or of the practice that the teacher carries out on the planning, development and evaluation of the training process. Pedagogical and didactic elements are interwoven in them in a simultaneous, complementary and antagonistic way, constituting their complex character. Their recognition allows for progress in relation to the understanding of the meanings and forms

in which teachers develop their teaching work. This is how research on the ways in which the construction of pedagogical and didactic knowledge is configured based on reflection on daily tasks in teaching scenarios and on the implementation of strategies and specific actions.

## References

- Almonacid, A., Merellano, E., & Moreno, A. (2014). Characterization of pedagogical knowledge: Study in new teachers. *Educare Magazine*, 18(3), 173-190. <https://www.redalyc.org/articulo.oa?id=194131745010>
- Botero, P., Salazar, M., Torres, M., & Pico, E. (2006). *Social Research: Understanding and Local Action in eight Caldas OIF*. Collection of advances at the Center for Advanced Studies in Childhood and Youth - CINDE.
- Cárdenas, A., Soto, A., Dobbs, E. & Bobadilla, M. (2012). Pedagogical knowledge: components for a reconceptualization. *Education and Educators*, 15(3), 479-496. <https://www.redalyc.org/pdf/834/83428627008.pdf>
- Coll, C. & Solé, I. (2002). Teach and learn in the context of the classroom. In C. Coll, J. Palacios, & A. Marchesi, *Psychological Development and education 2. Psychology of school education* (pp. 367-386). Alliance.
- Colomina, E. &. (2001). Interactivity, mechanisms of educational influence and construction of knowledge in the classroom 2. *Psychological Development and Education*, 437-460.
- Congress of the Republic of Colombia. (December 28, 1992). *Law 30 of 1992*. <https://www.alcaldiabogota.gov.co/sisjur/normas/Norma1.jsp?i=253>
- Congress of the Republic of Colombia. (February 8, 1994). *General Education Law*. [https://www.funcionpublica.gov.co/eva/gestornormativo/norma\\_pdf.php?i=292](https://www.funcionpublica.gov.co/eva/gestornormativo/norma_pdf.php?i=292)
- National Council of Higher Education (CESU). (2017). *Superior Agreement 2034. Proposal of public policy for the excellence of higher education in Colombia in a peace scenario*. [https://www.siteal.iiep.unesco.org/sites/default/files/sit\\_accion\\_files/siteal\\_colombia\\_0404.pdf](https://www.siteal.iiep.unesco.org/sites/default/files/sit_accion_files/siteal_colombia_0404.pdf)
- Daiute, C., & Lightfoot, C. (2004). *Studying the Development of Individuals in Society*. [https://www.psy.au.dk/fileadmin/site\\_files/filer\\_psykologi/dokumenter/CKM/NB40/Daiute\\_lightfoot.pdf](https://www.psy.au.dk/fileadmin/site_files/filer_psykologi/dokumenter/CKM/NB40/Daiute_lightfoot.pdf)
- Daiute, C., Botero, P., Calle, A., Lugo, N. V., Pinilla, V. E., Ríos, D., Zuluaga, I. (2007). *Young people in conflict write about the future: International perspective on socio-political and cultural conflict from the narratives of young people from three regions of the world: Croatia, Colombia and the United States*. National investigation. Manizales: Center for Advanced Studies in Childhood and Youth of the University of Manizales.
- Darlene, E. (2003). Towards a paradigm of complexity in teaching - learning of the social sciences: A critical reflection from practice. *Foundations in Humanities*, 7-8, 103-128. <https://dialnet.unirioja.es/descarga/articulo/1273089.pdf>

- De Lella, C. (September 1999). Models and trends in teacher training. *Workshop seminar on teacher profile and training strategies*. <https://www.oei.es/historico/cayetano.htm>
- National Planning Department. (2018-2022). *National Development Plan 2018-2022. Pact for Colombia, pact for equity*. <https://colaboracion.dnp.gov.co/CDT/Prensa/Resumen-PND2018-2022-final.pdf>
- Díaz, V. (2006). Teacher training, pedagogical practice and pedagogical knowledge. *Laurus Journal of Education*, 12, 88-103. <https://www.redalyc.org/pdf/761/76109906.pdf>
- García, B., Loredo, J., & Carranza, G. (2008). Analysis of the educational practice of teachers: Thought, interaction and reflection. *Electronic journal of educational research*, 10, 1-15. [http://www.scielo.org.mx/scielo.php?script=sci\\_arttext&pid=S1607-40412008000300006&lng=es&tlng=es](http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1607-40412008000300006&lng=es&tlng=es)
- García, L., & Salazar, M. (2016). Family upbringing in marginal contexts of Cali. *Amphora*, 20 (34), 37-58. <https://doi.org/10.30854/anf.v20.n34.2013.52>
- González, H., & Ospina, H. (2013). The Pedagogical Knowledge of university teachers. *Virtual journal of Universidad Católica del Norte*, 95-109. <https://revistavirtual.ucn.edu.co/index.php/RevistaUCN/article/view/429>
- González, H., & Sánchez, T. (2016). Pedagogical knowledge: foundation of the teaching exercise. *Educ. Educ.*, 19(2), 241-253. doi: 10.5294 / edu.2016.19.2.4
- Darlene, E. (2003). Towards a paradigm of complexity in teaching - learning of the social sciences: A critical reflection from practice. *Foundations in Humanities*, 7-8, 103-128. <https://dialnet.unirioja.es/descarga/articulo/1273089.pdf>
- Melo, L. Ramos, J., & Hernández, P. (2014). Higher education in Colombia: Current situation and efficiency analysis. *Drafts of economics* (808). [https://www.banrep.gov.co/sites/default/files/publicaciones/archivos/be\\_808.pdf](https://www.banrep.gov.co/sites/default/files/publicaciones/archivos/be_808.pdf)
- Ministry of National Education. (July 25, 2019). *Decree 1330 of 2019*. [https://www.mineduacion.gov.co/1759/articles-387348\\_archivo\\_pdf.pdf](https://www.mineduacion.gov.co/1759/articles-387348_archivo_pdf.pdf)
- Ministry of National Education. (s.f.). *The National System of Tertiary Education*. [https://www.mineduacion.gov.co/1759/w3-article-355208.html?\\_noredirect=1](https://www.mineduacion.gov.co/1759/w3-article-355208.html?_noredirect=1)
- Ministry of Higher Education. (December 2016). *Higher Education Bulletin. Coverage rate and concentration of Higher Education in Colombia*. [https://www.mineduacion.gov.co/1759/articles-359643\\_recurso\\_1.pdf](https://www.mineduacion.gov.co/1759/articles-359643_recurso_1.pdf)
- Morin, E. (1994). *Introduction to complex thinking*. (M. Pakman, Trad.) [http://cursoenlineasincostoedgarmorin.org/images/descargables/Morin\\_Introduccion\\_al\\_pensamiento\\_complejo.pdf](http://cursoenlineasincostoedgarmorin.org/images/descargables/Morin_Introduccion_al_pensamiento_complejo.pdf)
- Morin, E. (1999). *The seven necessary knowledge for the education of the future*. (M. Vallejo-Gómez, Transl.) Santillana.
- Noguera, C. E., & Marín, D. L. (2017). Knowledge, norms and subjects: questions about pedagogical practice. *Educar em Revista* (66), 37-56. <https://www.scielo.br/pdf/er/n66/0104-4060-er-66-37.pdf>
- Ospina, C. A., & Botero, P. (2007). Narrative aesthetics and construction of the public. *Latin American Journal of Social Sciences, Children and Youth*, 811-840. <http://www.scielo.org.co/pdf/rlcs/v5n2/v5n2a10.pdf>
- Pérez, M. R., & Fonseca, G. (2011). Pedagogical knowledge: An approach from the thought of Eloisa Vasco Montoya. *Colombian Journal of Education* (61), 221-251. <http://www.scielo.org.co/pdf/rcde/n61/n61a10.pdf>
- Prieto, B. (2012). Reviewing teaching practice. *Sophia. Journal of Research in Education* (8), 36-46. <http://contexto.ugca.edu.co/index.php/sophia/article/view/8/27>
- Rodríguez, Y. (2010). The pedagogical practice from a problem point of view. *A proposal for teacher training*. 13(1), 81-85. <https://dialnet.unirioja.es/descarga/articulo/3366046.pdf>
- Shulman, L. (1989). Research paradigms and programs in the study of teaching: a contemporary perspective. In M. C. Wittrock. *Research in teaching I*. Paidós.
- Zabala, A. (2020). *Educational practice. How to teach*. (S. Esquerdo, Transl.) Graó. <https://des-for.infed.edu.ar/sitio/profesorado-de-educacion-inicial/upload/zavala-vidiella-antoni.pdf>
- Zabala, S., Ardila, D. A., García, L., & de Benito, B. (2020). Game Based Learning (GBL) applied to the teaching of mathematics in higher education. A systematic literature review. *University training*, 13(1), 13-26. doi: 10.4067 / S0718-50062020000100013
- Zuluaga, O. (2006). *Relations between pedagogical knowledge, pedagogical practice and active memory of pedagogical knowledge*.