

## Active learning and territorial sustainability.

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### ABSTRACT

The present article revolves around the influence of reflexive activity on students learning achieved, to elaborate proposals to a problem of sustainability of aquaculture activity in a territory of Morelos State. The learning in the definition of solution proposals was studied, distinguishing a phase prior to its application (*pre-practice*), an application phase (*in practice*) and an after-application phase (*post-practice*). The study was developed along a 12-week course oriented to environmental planning, in a group of Biology students at Mexico University. The solution heuristic route contemplated three moments: sustenance, direction and viability. To gather learning information of this route, written report and a structured interview were used. Later, information was processed through a rubric, elaborated based on heuristic route realization conditions, specifically designed to estimate distinct levels of learning. These moments of reflection were studied as elements of active learning built from the students and their study was carried out through a structured rubric with inquiry questions. Medullary reflexive activity was found in the degrees of "reflexive action" and "reflection", which played a differential role in three studied phases (*pre-practice*, *in the practice* and *post-practice*). In the phase *in practice*, the degrees of reflection allowed to glimpse routes of solutions adjusted to the context and an articulation of the theoretical knowledge with the situational ones. While, in the *post-practice* phase, it allowed them to detect the critical transformations carried out by them, as well as the integral articulation of the heuristic route with the solutions of greater predictive ability.

**Key words:** Active learning, Heuristic route, Reflexive activity, Problem solving, Sustainability transformational.

### RESUMEN

El presente artículo gira en torno a la influencia que tiene la actividad reflexiva sobre el aprendizaje logrado en los

alumnos para elaborar propuestas a una problemática de sustentabilidad de la actividad acuícola en un territorio del Estado de Morelos. El aprendizaje en la definición de propuestas de solución se estudió distinguiendo una fase previa a su aplicación (*pre práctica*), una fase de aplicación (*en la práctica*) y una fase posterior a la aplicación (*post práctica*). El estudio se desarrolló a lo largo de un curso de 12 semanas orientado a la planeación ambiental, en un grupo de estudiantes de Biología en una Universidad de México. La ruta heurística de solución contempló tres momentos: sustento, dirección y viabilidad. Para recabar la información de aprendizaje de dicha ruta se emplearon el reporte escrito y una entrevista estructurada. Posteriormente la información fue procesada mediante una rúbrica, elaborada con base en las condiciones de realización de la ruta heurística, diseñada específicamente para estimar los distintos niveles de aprendizaje. Dichos momentos de reflexión se estudiaron como elementos del aprendizaje activo construido desde los alumnos y su estudio se realizó mediante una rúbrica estructurada con cuestiones indagatorias. La actividad reflexiva medular se encontró en los grados de "acción reflexiva" y la "reflexión", los cuales jugaron un papel diferencial en las tres fases estudiadas (*pre práctica*, *en la práctica* y *post práctica*). En la fase de *pre práctica*, los grados de reflexión señalados permitieron al alumno hacer una transición de elementos aislados y desarticulados a una experiencia de carácter más integral. En la fase *en la práctica*, los grados de reflexión permitieron vislumbrar rutas de soluciones ajustadas al contexto y una articulación de los conocimientos teóricos con los situacionales. Mientras que, en la fase de *post práctica*, les permitió detectar las transformaciones críticas realizadas por ellos, así como la articulación integral de la ruta heurística con las soluciones de mayor capacidad predictiva.

**Palabras clave:** Aprendizaje activo, Ruta heurística, Actividad reflexiva, Solución de problemas, Sustentabilidad transformacional.

## INTRODUCTION

In front of the environmental crisis, with the threat that this entails from the destruction of the world as we now know it, the imperative of a professional education oriented to the transformation of concrete realities has been recognized (Nguyen et al. 2014). In the environmental field, this training has been recognized as "transformational sustainability" (Wieck et al. 2012) and it is concerned with preparing professionals to acquire the competence to define proposals with the possibility of influencing changes that bring or improve the sustainability. Always recognizing that solving problems in this field does not only depend on learning to define proposals, but generally involves modifications of a different nature such as institutional, political or economic (Di Gregori et al. 2004).

Training professionals so that they can define proposals aimed at transiting towards sustainability is an educational challenge, because by its nature, the problems that arise in this field are not usually solved easily (Steinemann 2003) or by simple means (Funtowicz and Ravetz 1993; Dovers 1996; Wiek et al. 2011). The solutions of sustainability problems are of such a nature that they are recognized as complex in such a way that they can be called proactive strategies. These strategies can be shaped by heuristic routes that contain sequences of articulation of actions and processes and, when they are installed as objects of learning, they force to generate processes capable of attending to diverse cognitive demands. These demands are originated fundamentally by the conditions that the good proposals of solution must fulfill, of which three of them are studied here: sustenance, direction and viability (Bammer 2005).

The condition of sustenance refers to the requirement to establish the relevance of the change that seeks to generate the proposal and that agglutinates the set of explanatory arguments built around the sought transformation (Nguyen et al. 2014). In an educational process, this entails the didactic task of going against the tendency of students to formulate arbitrary or isolated proposals, distant from the context in which they seek to influence (Hawes 2003). The result of this work would be the definition of targets for intervention by students who not only specify what is necessary to transform, but also to widely justify the desired change, always in the context where they work (Sipos et al. 2008).

The condition of direction requires that the proposal be oriented to convene collective efforts, that is, to mark an orientation to develop joint and coordinated strategies to solve sustainability problems (van Kerkhoff and Lebel 2006, Blackstock et al. 2007). Under the training, this leads to the student learn to overcome the formulation of individual, arbitrary and risky solutions. First, by selecting alternatives that offer more than they can cost, making an effort to predict the probable consequences of possible courses of action (Covitt et al. 2009). Secondly, management has a demand for collectivity, which implies that students must learn to recognize the plurality of sustainability contexts and to move towards the aspirations and needs of most actors (Moreno et al. 2014).

The viability condition requires that the definition of proposals consider both critical resources and the plural and often conflicting nature of sustainability contexts (van Kerkhoff and Lebel 2006). In this case, the educational work has to advance towards the overcoming of the ingenuous conceptions of the solutions and to recognize the necessity of a learning, very own of the transformational sustainability, of

investigating and applying knowledge coming from different sources to deal with both the limitations existing in the context, as with the different values and political interests of the actors (Wiek et al. 2012). Here the students' learning focuses on the understanding of strategic concepts such as intentionality, systemic inertia, road dependencies, barriers, carriers, alliances (Brown 2008).

As can be seen in the previous paragraphs, the development of thinking towards sustainability with a transformational approach leads to cognitive demands that are not easy to satisfy. The educational improvement makes it imperative to resort to didactic options capable of responding to the demands of sustainable training. A didactic option like the one indicated is represented in active learning, a generic term that refers to different educational currents that encourage the participation of the student in their own education, such as self-regulated learning, reflective thinking, problem-based learning and others more (Pinsky et al. 1998). From this perspective, an active student is one who exercises some control over their own training by taking initiatives in that direction and differs from the limited passive student to comply with the teaching slogans, thus relegating all responsibility for their training (Lord et al. 2012).

The activity that is investigated here is reflective and it is thought that it can positively influence the formation of a thought towards sustainability which, to be given, has the main requirement that the student interacts with a given situation<sup>1</sup>. The reason to suppose the beneficial effect of the reflection is in the improvement of its capacity to articulate

different types of knowledge (Barba et al. 2014, Bell et al. 2011), which constitutes a cognitive demand very typical of the training sustainable. Likewise, findings have been found about the effect of reflexive practices on the ability to discover the existing articulation between the processes that make up a situation (Denton 2011, Pretorius and Ford 2016), which in this case would be a vital capacity for students capture the problematic situation in an articulated way. There are also investigations that indicate how reflective practices can help detect the positions of the actors in a given reality (Hawes 2003). The studies on the effect of reflection on the unveiling of strategies in contexts of limited conditions and conflicts of interest (Moreno 2014), qualities that tend to occur in problematic situations within the scope of sustainability, cannot be overlooked.

Recognizing the relevance of training towards transformational sustainability, the cognitive demands that it entails and the potential of reflective thinking to meet these demands, the questions that guided the research are the following: Which are the particularities that students exhibit in learning of the proactive strategies? What type of reaches and limitations presents the reflective thought of the students? What kind of reflective practices demand the formation towards the sustainability within its transformational approach?

## MATERIAL AND METHODS

The work was developed in a Mexican university along a final course of a Degree in Biology

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<sup>1</sup> The notion of situation has different meanings, here it is interpreted in a way that coincides with authors such as Clandini (1986); Clarà (2013); Dewey (1933); Couple Roblin & Margalef (2011), who highlight her epistemological meaning to designate a cut of reality that is located in a specific space, which is experienced as an articulated global whole and from a specific focus or view.

oriented to the environmental planning of the aquaculture activity. The course was developed in a territory located in the State of Morelos, which had been analyzed in previous courses by students through defined indicators to estimate territorial sustainability. The experiences of the students on the Morelense aquaculture activity were resumed so that, from there, the learning process began to define proposals for sustainability issues in the studied territory.

The course started with the results of the territorial analysis so that the students could learn how to use them in order to define the sustainability issues of the territory in question. The method of study used was non-randomized observational diagnostic research (Vandenbroucke 2004) in which 42 students accepted, 22 of whom were men and 20 women and all in an age that ranged from 21 to 24 years old.

The unit of analysis of the research was the student and each of them was estimated the degree of learning achieved in planning, applying and resuming a heuristic route to define solutions to the problem of territorial sustainability detected. This heuristic route was studied during an environmental planning course and three great moments were distinguished: sustenance, direction and viability. The time of sustenance was differentiated in turn into three fields of learning: identification of problems, investigation of problems and definition of intervention targets. At the time of management, two fields were differentiated: research on alternatives and selection of alternatives. At the time of viability, two fields were differentiated: operative evaluation and viability evaluation. In this way, a total of seven learning fields were defined (see Table 1).

The achievements obtained in each field were estimated through the analysis of a written report of territorial planning made by the students, which at the express request of the researchers delivered the

students. In this report the students articulated knowledge of different types, ordered in each of the moments (livelihood, direction and viability). To the analysis of the written report was added a structured interview about the activity carried out by the students in the phases of: pre practice, in practice and post practice, where their realization was detailed and the doubts that could arise about the work of the students.

The instrument used to evaluate the information obtained from the written reports and the structured interview was a rubric specifically designed to estimate learning in the definition of proposals for solving territorial problems. In this rubric, levels were differentiated in each of the seven learning fields by establishing "execution conditions", which were used as decision rules to estimate the different levels of learning in each defined field (Table 1). In this way, the student who fulfilled all the conditions obtained the highest level and those who showed greater limitations were assigned to lower levels, in proportion to the number of limitations detected. For this estimate of levels, a Likert scale was used, which ranged from 1 to 5, where 1 was the lowest achievement of learning and 5 was the highest.

The estimation of the reflective activity of the students involved dividing it into phases and degrees of reflective depth. For the differentiation of the reflection phases, the categorization used by Pinsky and collaborators (1998) was taken up again, who distinguished the reflection in: pre-practice, in practice and on practice. The three phases of reflection were evaluated through the establishment of four degrees of reflective deepening taken from the works of Mezirow (1991)<sup>2</sup>: "Habitual action", "Reflective action", "Reflection" and "Critical reflection". Each of these degrees of reflection was analyzed through basic questions of inquiry (see Table 2), which allowed us to estimate the deepening

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<sup>2</sup> For some decades, the degrees of reflective deepening have been recognized and different authors have proposed different classifications of them to make an abstract notion such as reflection operational. Some of the classifications by degrees of reflection more recognized are the Boud and collaborators (1985): those who differentiated them in: association, integration; validation and appropriation, Hatton and Smith (1995) who proposed the description, descriptive reflection, dialogical reflection and critical reflection and Moon (1999) who differentiated: notice, make sense, make sense, work with meaning and transformative learning.

**Table 1:** Implementation conditions established for the design of the rubric used in the estimation of the students' degree of learning.

LEARNING FIELDS		CONDITIONS OF REALIZATION BY LEARNING FIELDS
SUSTENANCE	Problema identification	<ul style="list-style-type: none"> <li>• Defines a universe of observation of the situation according to the normative model</li> <li>• Contemplate the significant central aspects of the situation</li> <li>• Organizes and systematizes the problems found</li> </ul>
	Problem investigation	<ul style="list-style-type: none"> <li>• Applies the underlying scientific principles to specific situations</li> <li>• Use sufficient knowledge to understand the underlying causes of problems</li> <li>• Perceive the different situations of the actors and their vision of the problems</li> </ul>
	Definition of intervention targets	<ul style="list-style-type: none"> <li>• Locate options for necessary and feasible changes</li> <li>• Contemplate the effects of the exchange option from an integral perspective</li> </ul>
DIRECTION	Investigation of alternatives	<ul style="list-style-type: none"> <li>• Uses evidence that indicates the likelihood that the options for change can really affect the objective situation</li> <li>• Justify the options for change according to the different needs and interests of the interested parties</li> </ul>
	Selection of alternatives	<ul style="list-style-type: none"> <li>• Identifies divergent values and preferences of interested parties</li> <li>• Interpret the option of change in an integral way, recognizing the possible ways of participation of interested parties</li> </ul>
VIABILITY	Operational evaluation	<ul style="list-style-type: none"> <li>• Poses options for change in congruence with existing critical resources</li> <li>• Consider possible obstacles and impediments to the implementation of the identified change options</li> </ul>
	Evaluation of the viability	<ul style="list-style-type: none"> <li>• Contemplate the political possibilities of implementing change options</li> <li>• Detects possible transition paths to implement the changes</li> </ul>

of the reflection in each grade, also on a scale of 1 to 5, where 1 indicated the lowest depth of reflection and 5 the greatest.

The exploratory questions were adjusted to each phase in the following way: in the reflection in the pre practice they were adjusted with the objective of investigating the student's activity to guide their future practice within a normative framework and to estimate their degree of awareness of why perform the solution heuristic route. They were also adjusted to estimate the sense that the students gave to the basic structural elements identified and to evaluate the degree of flexibility in their way of proceeding within a suggested route. This reflection was estimated after the students learned the bases to project their actions, in parallel to the realization of a project requested to them in which they established a route of realization to formulate proposals of solution to the problems of territorial sustainability.

Reflection in practice refers to the student's flexibility to readjust actions at the moment he applies the heuristic route to solve problems. In this phase the questioning questions were adjusted to account for

how the students shaped the problem, readjusted their actions to the context and formulated possible solutions to the problems and from what (disciplinary or interdisciplinary) approaches they formulated them. This type of reflection was evaluated at various points in the course as the students became involved in the realization of the explicit learning fields in Table 1. Inquiry questions were adjusted to investigate from the way they collected the information, to the enrichment or transformation of their practice through the incorporation of scientific and non-scientific knowledge.

In the post-practice reflection, the adjustment of the exploratory questions involved investigating from what, how and for what they carried out the heuristic route of problem solving, until delving into the facts with a view to discovering what could have been done in a better way. Through these questions of inquiry, the ability of students to detect isolated critical transformations was estimated. It also helped to examine the work of the students to articulate the different moments of the solution route and to envision alternative paths better adapted to the

**Table 2:** Inquiry questions used to design the rubric used to estimate students' reflexive activity.

DEGREES OF REFLECTION	BASIC INDICATIVE QUESTIONS
Habitual action	<ul style="list-style-type: none"> <li>• What have you learned from what you have done?</li> </ul>
Reflective action	<ul style="list-style-type: none"> <li>• Did you think if what you did went well?</li> <li>• Did you consider if the results you obtained with what you did were correct?</li> <li>• What could I have done better?</li> <li>• Do you think the logic of the actions you did is adequate?</li> </ul>
Reflection	<ul style="list-style-type: none"> <li>• What would be the usefulness of what you do?</li> <li>• Did you think if what you did was linked coherently with the purpose sought?</li> <li>• Do you know the reasons for what you did?</li> <li>• Do you know how you relate to other types of activities?</li> </ul>
Critical reflection	<ul style="list-style-type: none"> <li>• Did you improve some aspect of what you did?</li> <li>• Did you identify another way to do it better?</li> </ul>

context.

To analyze the results of the learning achieved in the learning fields as in the reflexive activity, the cluster analysis was used to differentiate groups of students with similar characteristics. The groups of differentiated students were analyzed through the use of radial graphs that allowed to compare the differences between the groups in an integral way, that is, from the set of their differences and similarities.

## RESULTS AND DISCUSSION

The training to define proposals to complex problems, from the perspective assumed in this study, constitutes an educational environment that implies: learning to sustain them, guiding them in a socially acceptable direction and instituting them with the highest probabilities of concretion. This involves a wide range of educational challenges, all of them very typical of sustainable training, which can generate different responses in students. Therefore, it is understandable the wide range of general averages of learning found in the students studied, which ranged from values of 2.1 to 4.9. This diversity was analyzed through a cluster analysis that made it possible to

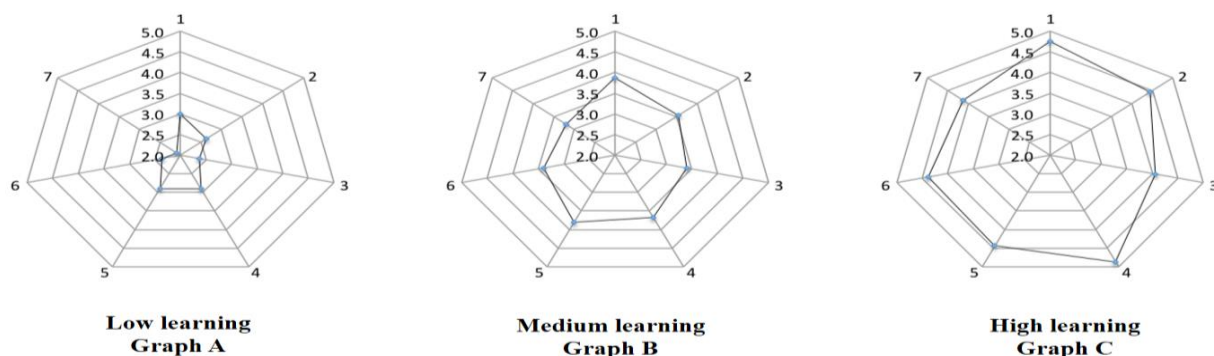
group students according to their learning outcomes in three groups, which could be classified into low, medium and high learning (Fig. 1).

The low learning group was formed by 11 students representing 26.2% of the sample, with a general average of 2.6 the variation in the different learning fields is shown on graph A of Fig. 1. These students presented limitations in all the learning fields, but mainly in relation to evaluating the viability of the proposals. The group of medium learning (graph B of Fig. 1) was composed by 15 students, 35.7% of the studied group, that showed a general average of 3.6 learning and a series of similar limitations in each field of learning. The high learning group (graph C of Fig. 1) was formed by 16 students, 38.2%, who presented a general average of 4.4, with the highest achievements in the investigation of problems and with the least limitations in the evaluation. of the viability of the proposals (Fig. 1).

### *Learning fields in the livelihood condition*

Learning to sustain a solution proposal entails three educational challenges, that are very typical of sustainable training: a) the challenge of integrating knowledge of different types<sup>3</sup> within a normative framework, where you perceive the purpose of your

<sup>3</sup> The differences in the types of knowledge discussed here have at least three dimensions: differentiated by their disciplinary origin that allows them to be distinguished as biological, economic, political knowledge, etc.; differentiated by gnoseological criteria to separate them into scientific and non-scientific knowledge and finally differentiated by their function in theoretical, procedural and conditional knowledge.

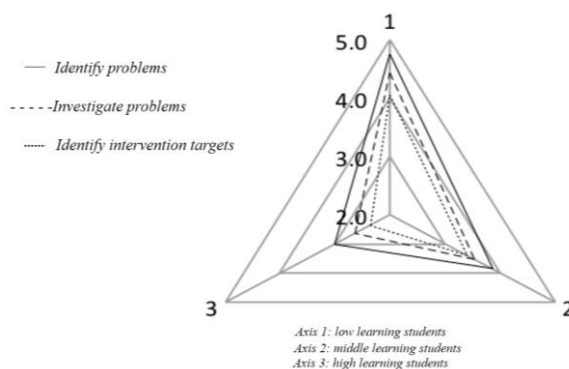


**Fig. 1:** General averages of learning found for each of the seven learning fields studied and differentiated for each of the three defined groups of students.

work (Sipos et al. 2008), b) the challenge of resorting to the theory to explain or give meaning to facts of reality with the basic structural elements of the problem to be solved (Barba et al. 2014) and c) the challenge of interpreting one or several events within the framework of a comprehensive understanding of reality that favors the definition of a way forward to achieve the finality (Denton 2011).

The results obtained show that the low learning group (axis 3 of the graphs of Fig. 2) present notorious limitations in the three referred challenges. By delving into these results with the help of interviews, it was possible to detect that these students did not manage to give a comprehensive outlook of the territory due to their limitations in articulating different types of knowledge, that led them to have fragmented or partial visions. The latter culminated in the inability to perceive the problem in an integral way, such as fragmentation, pauperization and the existence of a structure of ecological services incompatible with the demands and needs of the human communities settled in the territory. Instead, these students only perceived specific problems such as the damaged natural areas or the problem of the lack of basic services in some urban areas.

A major limitation of learning occurs in the field of problem research, limitation that happens in the three groups of students, but more noticeably in



**Fig. 2:** General averages of learning found for each of the seven learning fields studied and differentiated for each of the three groups of students defined

the medium and low ones. Above all, these last students missed the central causality of the problem based on the fact that past and current management of the territory studied has responded to only one criterion: the economic profitability. The students here present diverse degrees of what Zemelman (1987) defined as the "critical use of theory" to refer to the fact of resorting to scientific knowledge to recover the richness in the interpretation of concrete realities. Also, the low level of learning in this field

was caused by the difficulties of the students to perceive the different situations in which the actors find themselves and that generate different visions around the territorial problems. Overall, the mentioned limitations caused in the students, an incomplete trim of the situation that left out significant aspects, due in large part to the predominance of disciplinary schemes that biased their conceptualization of the situation and interfered with them to thinking about in a way not previously determined.

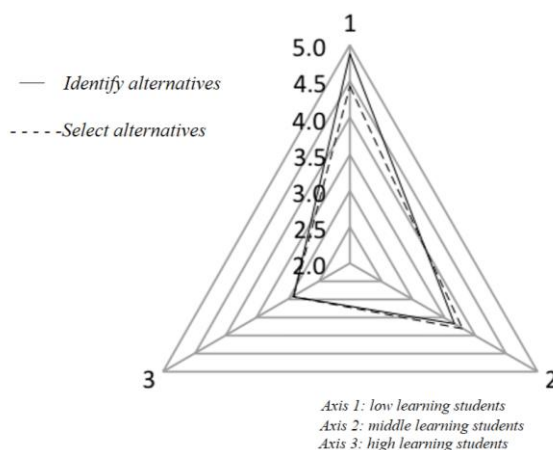
In the Fig. 2 it can be seen that the biggest learning obstacle detected was located in the field of identification the intervention targets, whose central challenge was to interpret events in an integral framework. More concretely, the students here had to learn to identify suitable and possible changes to guide the territory towards sustainability. The changes can only be justified by the nature of their impact, a condition that forces us to always keep in mind the integral nature of the context. But the results indicated the difficulty that students represent in articulating processes, since it requires that each one of them be analyzed in terms of their relationships with others. In addition, the difficulty was complicated due to the fact that the aforementioned articulation tends to launch different areas of reality that are different and far from the established theoretical domains. But students with greater limitations could only establish possible relationships under theoretical dimensions, mainly ecological and economic.

### *Learning fields in the address condition*

In the framework of learning to define proposals, the condition of direction means the achievement of building knowledge to shape the problem, contextualize it to the real situation and recognize fields of options to be made. This can have different aspects, the two studied groups in this work refer to options that can really generate the desired change and to options that respond to social interests. Without these features, the proposals are reduced to some arbitrary projections and overcoming, this

implies learning to identify the potentials that various social actors can activate. If we look at Fig. 3, several students located on axis 1 of high learning, managed to distinguish the viable of the purely desirable and to detect the options with real possibilities of summoning the action of a social will.

The limitations of the achievements presented by the students of medium and low learning indicate the difficulty that represents a formation to direct a transformative practice. One of the main learnings here, very typical of sustainable training, is to recognize the interests and needs of the actors and link this to the fact of detecting the objective possibilities of the options to guide a territory towards sustainability. The options discussed are not simple solutions, but involve establishing trajectories of integral modifications. But for a large number of students their limitations only allowed them to formulate sectorized and therefore partial and incomplete options of the relations between the environment, the territory and the social groups.



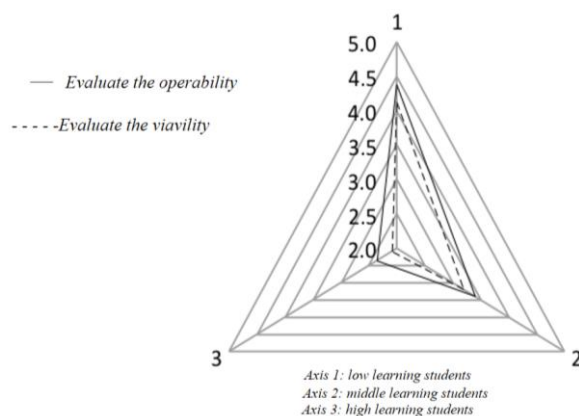
**Fig. 3:** General averages of learning found for the two fields of learning of the address condition.

### *Learning fields in the viability condition*

The viability condition is linked to tactical learning, unusual in schools, but of undoubted value to train in the direction of transformational



sustainability. The purpose of identifying critical transformations taking into account the possible (both of an operational nature associated with critical resources, and those of a political nature), was limited in each group. Likewise, the level of awareness for the integral articulation of the process followed and the level of self-criticism of its performance was presented in a limited manner. The Fig. 4 shows that all students presented a restricted learning in this field to define feasibility and that the limitations are greater to recognize the political constraints associated with the evaluation of viability.



**Fig. 4:** General averages of learning found for the two fields of learning of the viability condition.

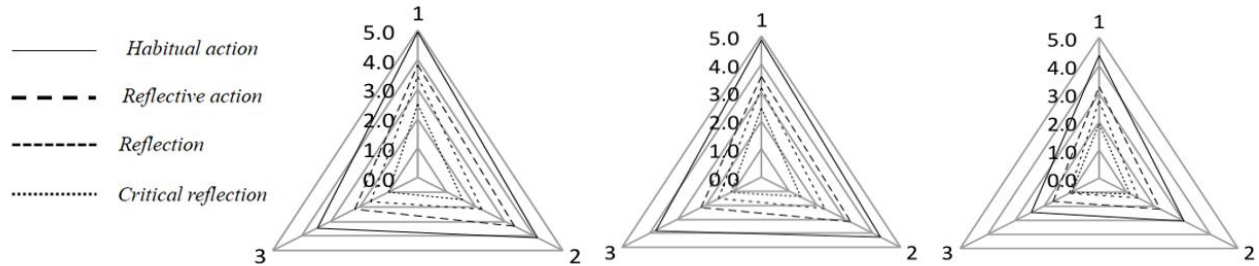
Particularly, in the students of low learning, severe impediments were identified to reconstruct the context where the social subjects are located, in such a way that they tend to propose isolated and specific solutions such as increasing the social capital of the actors through the establishment of events. that encourage their interrelation, but without linking this with the rest of the context. Through the support of the interviews it was observed that these students tend to link with relevant strategies that locate in the literature, come to understand their value, but tend to apply them mechanically overestimating their intrinsic value.

### *Reflective nature of the student*

Solving complex problems is a challenge for students because they are more accustomed to solving well-structured problems (Jonassen 2000), they also lack mental models developed in the learning fields in which complex problems take place. The interaction of the student with the problem by itself triggers a judgment of internal and external representations, which activates cognitive and perceptual processes, but at a level of "habitual actions" in the majority of the students and in the three planning moments: livelihood, direction and viability. Fig. 5 shows the averages of the reflective practices of the students in the three phases: pre practice, in practice and post practice. As can be observed when comparing graphs, A and B of the mentioned figured, the pre and practical phases exhibit a quite similar behavior, in fact, the general average of all reflective practices in both stages was 2.8. The post practice phase, observed in graph C of the same figure, also presents a variation in reflective grades similar to the previous phases, but with a lower activity that is reflected in a general average lower than 2.2. In the interviews it emerged that the lower tendency of the students to reflect on what they already did was largely due to the fact that several of them registered low self-awareness of the cognitive processes in the moments of reflection because they did not have information or reasons that would allow them to perceive their educational contribution.

The degrees of reflection reveal that the "habitual action" was always greater in high, medium and low learning students, with the difference that high learning students presented averages close to 5 and those of low and medium learning close to 3.5. Contrary results were found in the "critical reflection", whose average was 1.7 in the pre-practice phase, 1.6 in practice and 1.4 in the post-practice. The degree of "habitual activity" is a type of realization governed by rules that is basic to reach greater degrees of reflection. The data indicate that all students can process these experiences from this grade to an average depth. The degree of "critical reflection" involves transforming the experience to expand and rethink it, but this degree of reflection was far from the students, a result that is

The degrees of reflection reveal t.



**Fig. 5:** Averages of the estimation of the reflective activity of the students in the anticipatory phases, in practice and on practice.

understandable if one takes into account the complexity involved in situations framed in sustainability.

The degree of reflection "habitual activity" was accessible to all students, while the grade "critical reflection" was inaccessible for almost all, except in some exceptional cases. Therefore, in the intermediate degrees of reflection, represented by the "reflective action" and "reflection" is the key to understanding the differences of the reflective activity of the students. In the low learning, these reflective grades are almost not deepened, its overall average was 2 in the case of "reflective action" and 1.4 in the case of "reflection". While in medium and high learning students tend to deepen more noticeably in these degrees of learning, with averages of 3 or higher.

The degrees "reflective action" and "reflection" were not only the nuclei of differentiation of the reflexive activity, but also were key to explain the educational results of the students. These degrees of reflection played a very different role in the phases of pre practice reflection, in practice and post practice. In pre-practice the "reflective action" helped them to articulate their theoretical learning by allowing them to use the heuristic route as an articulating axis of their knowledge. The students pointed out that this degree of reflection was essential for ordering and

giving meaning to these experiences. Likewise, the degree "reflection" was pointed central to relate the heuristic route with a definite purpose and with this to broaden the meaning of it.

In particular high-learning students alluded to the degrees of "reflective action" and "reflection" carried out in the pre practice, as the key reflexive moments for their learning, since they allowed them to make a transition from isolated and disjointed elements to an experience of a more integral nature. This means that the students who were able to develop the reflective activity indicated, could deal with a wide range of knowledge of very different nature, articulate them from specific approaches and conclude with a comprehensive vision of the solution route and the elements that comprise it. On the contrary, limited students to perform the degrees of "reflective action" and "reflection" in pre practice, had important barriers to articulate their conceptual and methodological learning, which led them to fragmented and dispersed learning.

In the phase in practice, the degrees "reflective action" and "reflection" play a different role, since on the one hand they allowed to articulate the conceptual methodology with the situational aspects of reality, in such a way that they could adjust the heuristic route to the conditions of the context. On the other hand, it was detected that the degrees of reflective action

indicated when performed frequently generate the bases to deepen the sense of the heuristic route studied. This result is meritorious if one takes into account that a deep reflection is essential for the heuristic route to reveal viable solutions to the complex problems involved in territorial sustainability.

The role of reflective activity levels: "reflective action" and "reflection". In the post-practice was also relevant: first, it allowed the students to identify the critical transformations they made on their way of interacting with the problem and conclude with a different perspective of the heuristic route, in the second place it allowed them to glimpse alternative routes better adjusted to the context and, in third place, it allowed them to articulate the theoretical elements with the practical, substantial activity to be able to glimpse solutions with a greater predictive ability.

## CONCLUSIONS

There is a whole history around the analysis of the influence of reflection on learning, because since the time of Aristotle there was already discussion about practical judgment and moral action in his "Nicomachean Ethics" (Grundy 1982). In modern times, the most influential figure has undoubtedly been that of John Dewey (1933) with his studies on the use of reflective activity in learning. But despite its history there are still no agreements on the role and place of reflection in learning, however, an unusual way to interpret it is that reflection enhances the learning gained from an experience (Boud et al. 1985). Such an interpretation distinguishes three moments: 1) the student's experience, 2) the specific learning that takes place based on that experience and 3) the reflective activity necessary to build an extended learning. Thus, and from this interpretative perspective, the reflexive activity mediates between a specific learning and an extended learning. The data obtained in this study tend to agree with this interpretation.

According to Dewey (1933), the educational experience only occurs insofar as there is an interaction between a subject that learns and an object of learning. The problem is that, in training towards sustainability, the learning objects are usually so complex situations that the student must be prepared in advance to enable the interaction of the components before facing an apparently overwhelming complexity. Upon completion of their previous preparation, the student can project their interaction with the situation and this projection of their actions constitutes an object of learning that produces a specific projective-type learning, which is generated in the pre practical reflection phase.

The educative work proposed does not overcome the naive conceptions of the solutions to complex problems, nevertheless, it recognizes the need of a learning, very own of the transformational sustainability, of investigating and applying within a heuristic route, diverse educative strategies designed in attachment to minimize the deficiencies shown in this work.

The extended learning is not only crucial to interact with the problematic of the territory, representative in this case of the learning situation, but in some way sustains and enables the student to learn from other experiences. But because of the observational nature of the research, the results are provisional and only mark the beginning of a deeper work on the meaning of incorporating reflective practices in the expected learning within a framework of a training towards sustainability.

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