

Constructivism and learning by projects: environmental prospective strategies in the classroom of higher education

Constructivismo y aprendizaje por proyectos: estrategias prospectivas ambientales en el aula de la educación superior

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Contents

1. Introduction
 2. Academic reality
 3. Environmental perception
 4. From theory to application
 5. From the classroom to the extramural practice
 6. Conclusions
- Bibliographic references

ABSTRACT:

The variety of pedagogical strategies that can be implemented in order to guide theoretical and practical aspects, improve the communication channels and learning development in students of higher education. This research shows the significant experience of the professor-student-community relationship. The pedagogical strategy was developed by implementing two phases: theory application in the classroom and extramural performance. The extramural phase is developed in two environments: field research projects in the Meremberg Natural Reserve and building quality environmental education in urban green areas. The student stimulates the teaching-learning-teaching process and training in the competencies of being, knowing, doing and undertaking.

Keywords: Pedagogic culture, teaching tool, learning spaces, competences.

RESUMEN:

La variedad de estrategias pedagógicas pueden ser implementadas para guiar aspectos teóricos y prácticos, mejorar los canales de comunicación y el desarrollo del aprendizaje en los estudiantes de educación superior. Esta investigación documental muestra la experiencia significativa de la relación docente-alumno-comunidad. La estrategia pedagógica se desarrolló mediante la implementación de dos fases: la aplicación de la teoría en el aula y prácticas extramural. La fase extramural se desarrolla en dos entornos: proyectos de investigación de campo en la Reserva Natural de Meremberg y la construcción de una educación ambiental de calidad en áreas verdes urbanas. El alumno estimula el proceso enseñanza-aprendizaje-enseñanza y fortalece las competencias de ser, conocer, hacer y emprender.

Palabras clave: Cultura pedagógica, herramientas de enseñanza, espacios de aprendizaje, competencias.

1. Introduction

The learning process is created by the interaction between acquired knowledge, understanding and constant reflection. This relationship is the result of pedagogical strategies implemented in theoretical and practical Lectures in the university classroom and beyond (Remmen & Froyland, 2014; Al-Dojayli & Czekanski, 2017). These activities constitute a complementary process for the student integral formation and the acquisition of the competences of being, knowing, doing and undertaking (Kim & Lee, 2014; Nascimiento, 2015).

The constructivist approach given in the present article is specified by the pedagogical strategy development "Constructivism and learning through projects". It is carried out in the university Lecture 'Environmental Systems' of the fifth academic semester of Environmental Engineering program at the University Corporation of Huila Corhuila. This strategy has the purpose of contributing with the student's awareness to face their role as a professional with a holistic vision, which allows undergraduates to address modern environmental problems by offering tools and solutions that minimize their effects.

The strategy has two phases: the first phase is the theory application in the classroom, which comprises the competences of being, knowing and doing. The professor contributes to the competence's development based on the student's previous knowledge and the environment recognition, actions that promote the generation of proposals to solve local environmental problems, thus demonstrating the significant learning in the student.

The second phase is the extramural performance, which promotes the competences strengthening of being, doing and undertaking in two environments outside the university campus: the first environment with the research projects development in the Meremberg Natural Reserve and the second environment with the Environmental Education Construction with Quality (EECQ) that takes place in urban green areas.

The first environment of the second phase applies the learning theory through projects where the students propose a specific research project that is developed in the field. 100% of the projects must be adjusted due to student's confrontation with the environmental reality which is different from their conceptual imaginary in class. The second environment involves greater awareness in the teaching-learning-teaching process since this achieves an advance in the student's competences of doing and undertaking under two scenarios, i) high school institutions where educational talks and recreational-pedagogical activities are performed in environmental issues, and ii) intervention in urban green areas with the support of the surrounding community to clean and plant.

2. Academic reality

The knowledge construction is an integral process that requires continuity and growth from the individual to the collective and should have conceptual basis from learned knowledge (Wu, Wang, Spector & Yang, 2013). The triad shaped by the basic sciences analysis, the theories understanding and the permanent reflection towards the existing comprehension, allow to generate new knowledge in the pupil contributing to boost the learning process (Fullana, Pallisera, Colomer, Fernandez, & Pérez-Burriel, 2016; Capogna, 2017).

On the other hand, the Learning Theory through projects, contributes significantly to the new knowledge construction in different stages. Therefore, it becomes an alternative tool to consolidate the teaching-learning process with individual and collective scope (Harwell, 1997). Previous knowledge and experiences are key elements to generate new knowledge, the theoretical and practical activities inside and outside the classroom are a conceptual basis for the teaching-learning-teaching process (Remmen & Froyland, 2014).

Thus, the Environmental engineering program, through the transversally as a fundamental axis in the integration training, contributes to the skills development in students. This is based on the holistic context that professor's approach in the teaching-learning process to recognize the current dynamics of the environment, resulting in the professional has developed new skills and competences (Harjunen, 2012). The Lecture of Environmental Systems contributes to the awareness of the Environmental Engineering students in aspects such as dynamism, coherence and integrality.

3. Environmental perception

Global environmental issues affect the nature dynamics, emphasizing on goods and services produced by the assembly of species in ecosystems (Duncker, Raulund-Rasmussen, Gundersen, Katzensteiner, De Joung, Ravn, Smith, Eckmüllner & Spiecker, 2012). In addition, climate change alters and modulates the climatic conditions of the planet affecting the organism's stability and their interactions, along with the environmental imbalance (Feeley, Stroud & Perez, 2017). Regional and local environmental problems are more easily recognized, mostly by anthropogenic pressures, because they are presented daily, and the human being influence on the environment that surrounds it is appreciated, especially ecosystems near to the human settlements (Bar-Massada, Radeloff & Stewart, 2014).

The lack of actions which protect the nature and ecosystems that provide environmental goods and services to surrounding populations, are factors that synergistically generate a gradual deterioration of the environment (Feeley, Stroud & Perez, 2017). Some significant actions are: the species imbalance and the environment transformation (Mendoza-Hernández, Orozco-Segovia, Meave, Valverde & Martínez-Ramos, 2013), modern environmental problems occurrence of anthropogenic origin (Hidalgo, Castañeda-Chávez, Granados-Barba, & Sánchez-Domínguez, 2016), the urban growth that generates an ever greater demand of natural resources (Schneider, Logan, & Kucharik, 2012), change and transformation in the use of land for food security (Thenkabail, Hanjra, Dheeravath & Gumma, 2010), poor citizen participation with environmental sense (Wyness, 2015).

Currently, from the ambit of the Environmental Systems Lecture, the theory integration of class with reality, means that it is essential to interpret our environment from a different perspective. The first is from the citizens perception, which should consider the environmental care, having practices and actions aimed at the natural resources and ecosystems conservation. The second perspective is from the point of view of environmental engineering students, whose professional training is in process and all the information they have received in their first four semesters begins to become practical and applicable. This will be considered that the student role should start to transform, becoming an active person in society and as an integral citizen for the environmental protection.

4. From theory to application

During the academic semester development, the student has access to clear information about environmental issues recognizing possible causes, risks, threats and theoretical solutions. In the Environmental Systems Lecture, students integrate their acquired conceptual bases into the environmental reality of their nature, from the city, region, department, country to the planet (Ioan & Ursu, 2011).

When students integrate knowledge and construct proposals for real and tangible solutions, meaningful learning is developed, and it is the beginning of the student's potential role definition once they become professionals (Santos, Mesquita, Graça & Rosado, 2010).

The classroom is an everyday environment where the students propose their solution alternatives, the environmental problems analysis of the city, the region and their department. This allows the pedagogical exercise to extend the classroom boundaries. An activity that is promoted is the local environmental news consultation by radio or press in order to identify the needs of the community and the environment benefits that solving those need could carry, finding problem situations, the recognition of their causes, and the offering of solutions construct in the students a primary role of their functions in society, and from that step their ethics with the environment are fostered (Preston, 2011).

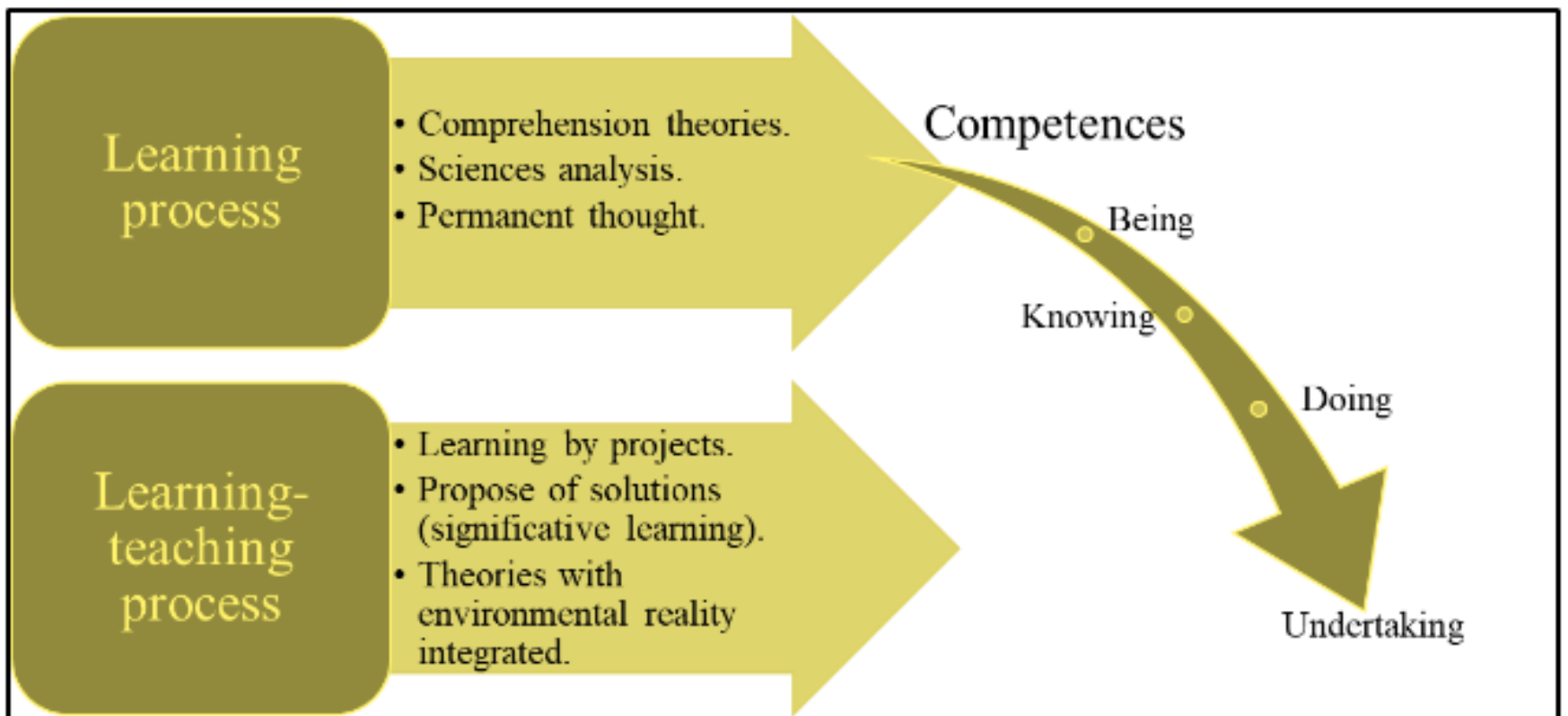
The application of theories and conceptual bases for the human being requires an attitudinal change. The Environmental Systems Lecture, promotes a constant search of proposals from students to solve environmental problems. This generates another activity that is the adoption of existing solution alternatives in academic texts for analysis and impacts on the environment. An extra activity is the new proposal of individual or collective solutions that are not found in academic texts, however, they are originated from their own analysis process and their previous knowledge strengthening the construction of new knowledge.

5. From the classroom to the extramural practice

5.1. Development and application of competences

The interest and performance of each student shows their competences evolution, which start from a solid base with the learning and teaching-learning processes that are continuous and daily (in this phase the knowledge competences and individual are developed), continues with the knowledge apprehension and recognition of their uses (doing competence development) and ends with the application to contribute to the problems solution (develops the competence to undertake) (Kim & Lee, 2014; Nascimiento, 2015) (Figure 1).

Figure 1
Processes at the competences level in the Environmental Systems Lecture.



5.2. First environment: 'field research projects in the Meremberg natural reserve'

The Meremberg Natural Reserve is part of the first civil society reserves created in Colombia, founded by the German Günter Büch in 1932 with 1,000 hectares of forests. It counts with 311.47 hectares, of which 56.96% are secondary forests, product of the human expansion process that generates a series of modern environmental problems and a sensitive decrease to the Meremberg Reserve stability (Carvajal, Rodríguez, Salazar, Martínez & Losada, 2017).

The field trips are an alternative stage for the teaching-learning process in accordance to the Learning Theory through Projects, where the university students apply their previous knowledge and those offered by the Environmental Systems Lecture to a current environmental reality (Harwell, 1997).

In the classroom, as a motivational introductory strategy, they obtain the necessary information so that they know what the reserve is, and what environmental problems are being presented. Later, groups of 3 to 5 students select a specific topic to be developed in the field, in coordination and permanent accompaniment of their professor. Students build the blueprint containing introduction, problem statement, research question, justification, objectives and methodology.

As previously indicated, during the field trip students develop their proposals, which in all cases should be adjusted to the reality they perceive, since the theoretical reality from the

classroom differs from the current environmental reality.

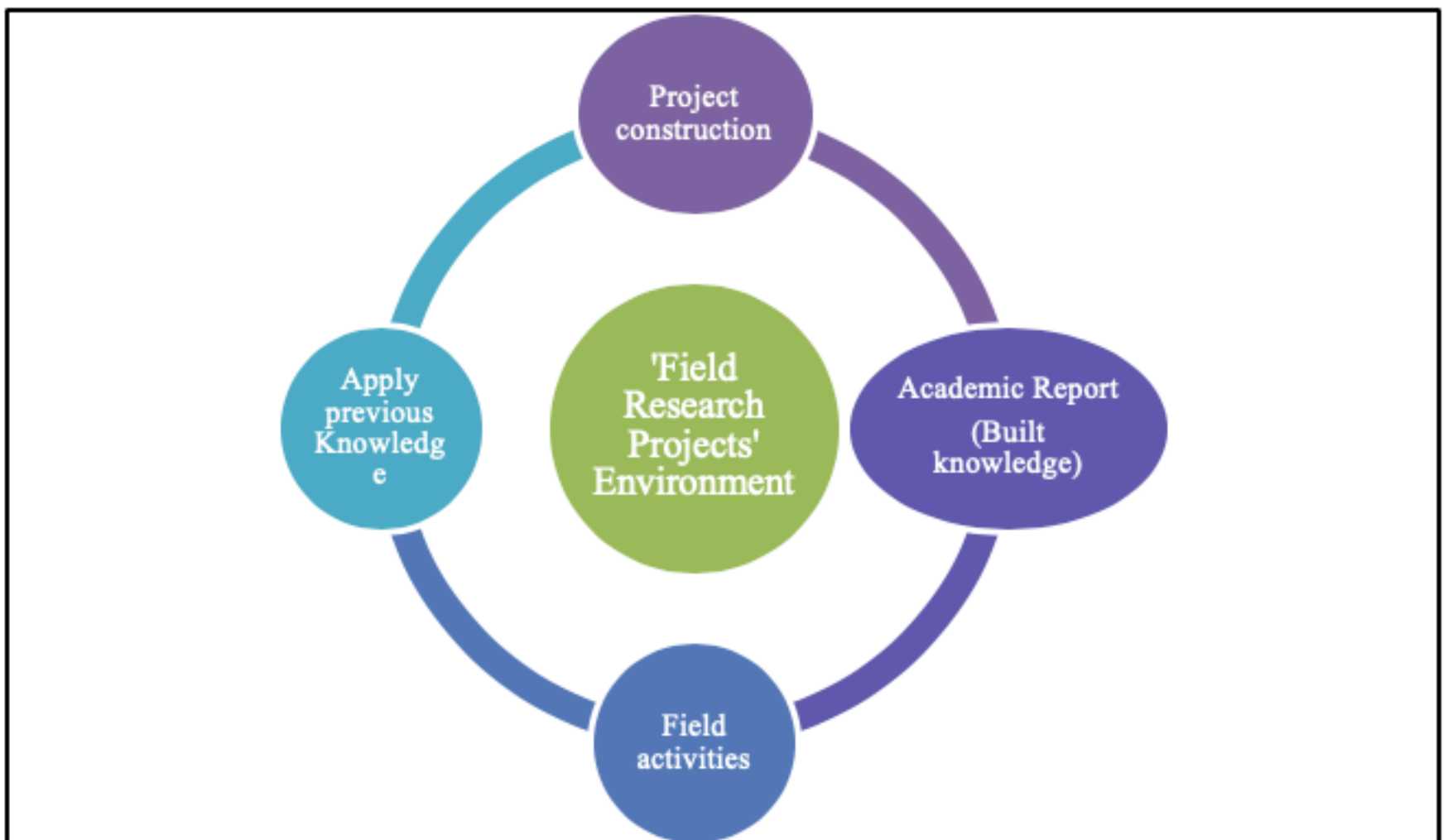
After a detailed review and in the exercise as university professors, it can be said that students have improved their ability to appreciate the environment, developing greater sensitivity due to anthropogenic pressures on nature, broadening their vision of environmental reality, approaching local problems that have regional impacts and rebuilding their own knowledge. Figure 2 shows a diagram of the first environment, it allows to visualize the teaching-learning-teaching process in university students.

After all this, they prepare a rigorous academic document, which is Lecture to evaluation by academic peers, the most complete and rigorous papers are published. Since 2010, around 21 reports have been published in the institutional journal of the Environmental Engineering Program. Among other results of great relevance, we can highlight: i) an increase of 23% in the last three years of the graduation modalities that require research, ii) participation in the national network of research with two oral presentations, iii) publication of a poster in the World Forum on Education in Engineering, 2013 and iv) an article published in an indexed journal about the teaching-learning strategy in the Meremberg Reserve (Carvajal, Rodríguez, Salazar, Martínez & Losada, 2017).

According to the above, the extramural practice is a pedagogical strategy that, through the development of projects, allows students to strengthen their academic and research skills, acquire a holistic vision of the environmental reality and become aware of their environment and, finally, recognize the current effects that the human beings have on natural resources (Nadelson, & Jordan, 2012; Korkmaz, Fakir, & Alkan, 2018; Losada, Carvajal, Rodríguez & Rodríguez, 2018; Rodríguez, Ramírez, Pastrana, & Carvajal, 2018).

Figure 2

First environment of Teaching-Learning-Teaching process.



5.3. Second environment: 'environmental education construction with quality'

The teaching-learning-teaching process is a practical exercise for the attitudinal and aptitude change of the student, in which they intervene directly in their local environment becoming a multiplier of the Environmental Education process that they receive in the Environmental Systems Lecture. Through students' subgroups, teaching activities are developed under two

stages: a) the first refers to the field of high school institutions and b) the second to urban green areas.

High School Institutions Stage.

In the first stage, the students approach the High School Institution. It starts with the administrative management directly with the school principal, followed by the academic coordinator and ends with the teachers of the environmental area. Subsequently, this continues with the selection and assignment of two high school courses that receive educational sessions for a year on environmental topics using a clear and specific language. Additionally, recreational activities are carried out as an alternative teaching method. The process is monitored every three months with written tests application to feed back the given knowledge and clarify the doubts.

The educational sessions do not last more than 20 minutes, each session is directed by the university student where they play the role of teacher for the first time, transmits their acquired knowledge and they are able to solve the questions of the high school institutions students. The recreational activities last between 30 and 40 minutes, in which the university student generates the enthusiasm necessary so that their students can strengthen the apprehension of new knowledge.

Among the most significant results we have: i) since 2013, 1.306 students belonging to 5 high school institutions of 'area 7' have been addressed in the city of Neiva, Colombia; ii) the issues that have been addressed for awareness are related to global climate change, environmental pollution, management of natural water resources and useful guidelines for proper recycling; iii) the natural science class is the preferred one for the acquired knowledge application; the active participation of students in the knowledge apprehension is highlighted; iv) recreational activities achieve the learning goal by playing with students, who have a participative and proactive attitude; v) in the first visit, 70% of the students remember the concepts and actions that were offered during the training and in the last visit it is reached up to 80%.

Urban Green Areas Stage.

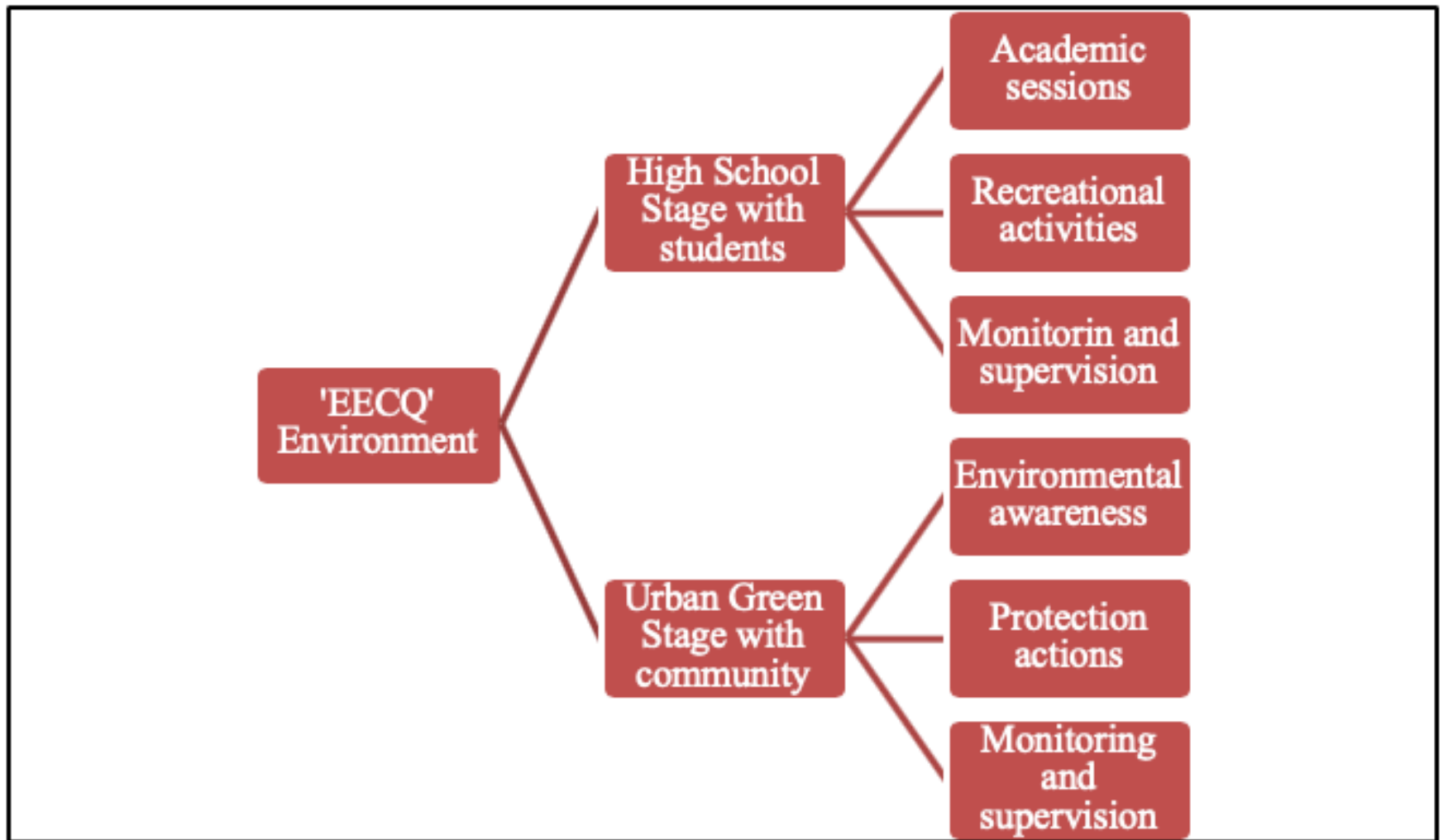
In the second stage, groups of university students are formed and an 'area 7' is selected. Administrative action begins with the Community President. Once the invitation is accepted, direct activities are arranged over a green area abandoned by the community.

In the first visit to the selected green zone, the surrounding community is invited to receive an environmental awareness directed by the university students. Later, they invite the residents near the green zone to accompany the cleaning actions, adaptation and planting of plants. In the second and third visits, the actions carried out are evaluated, by means of the conservation state of the green zone and formal interviews with the place residents; the acceptance of the university initiative is determined. On the fourth visit, the cleaning, adaptation and sowing actions are reinforced with awareness talks, where the university student plays a role as a counsellor for the attitude change of the citizens, summoning them to modify their view and their actions in favour of the environment. Subsequently, two new follow-up visits and final evaluation of the urban green area adaptation are made.

Among the most relevant results we have: i) 15 green areas of the city of Neiva intervened with the specific tasks of cleaning and sowing; ii) the surrounding community stands out for the appropriation and sense of belonging of their own green zone; iii) the last two follow-up visits show a reduction in community participation due to the multiple occupations of some residents; iv) recognition by the board of the Environmental Engineering Program of the University Corporation of Huila Corhuila with the promulgation of Resolution No.007 of 2015 as an institutional pedagogical program.

Finally, Figure 3 shows a diagram of what is presented in numeral 5.3. It allows to visualize the practice environments and diversify the interaction spaces that enable completing the teaching-learning-teaching process in university students for the development of the competencies of being, knowing, doing and undertaking.

Figure 3



6. Conclusions

The Environmental Systems Lecture contributes to the knowledge construction process in each university student, taking as a base the acquired knowledge and performing a constant exercise for the generation of new constructs focused on solving local and regional environmental problems.

The university students identify the problems that he or she wishes to propose alternatives solution, for this, the environments development allows to articulate knowledge and the generation of stages allowing to strengthen the teaching-learning-teaching process.

The products originated from the strategy "Constructivism and learning through projects" promote the investigative dynamism and community work which strengthens the integral formation of the university students

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[Index]

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