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Pedagogical Strategy For The Appropriation Of The Sustainable Development Goals, Sdgs, In Students Of The Environmental Engineering Program Of The Technological Units Of Santander, Colombia.

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Abstract.

The Sustainable Development Goals (SDGs), promulgated in 2015 as the global commitment to development by 2030, constitute the environment for the analysis of reality for the approach of potential solutions framed in the goals proposed in each of the 17 SDGs. Knowledge of the SDGs in all social spheres is essential for all actors to find their belonging to global development and to be able to assertively engage in the vision of change and progress promoted by the UN to transform the world by 2030. One of these charms is higher education, as framed by UNESCO, Education for Sustainable Development, should be framed at all levels of education, in higher education is required in two areas, for institutions to transform their scope and two for graduates to include in their professional profile, the vision of sustainability and integrality of actions to prevent or at least mitigate the environmental impacts that humanity has been generating. A pedagogical strategy mediated by learning objects, focusing the process on the student, so that he/she, with the guidance and company of the teacher, understands, appropriates and promotes knowledge applied to improve his/her living environment, makes the articulation of the SDGs more proactive, by allowing the student to analyze how his/her environment will improve with the focus of actions in the SDGs. The process advanced in the Sustainable Development course of

the Environmental Engineering program of the Technological Units of Santander in Colombia, showed that even though the students had some pre-knowledge in the environmental area, the recognition, validation and appropriation of the SDGs allowed them a comprehensive view of reality and a recognition of problems and solution possibilities, which contribute to the approach of goals that the 2030 Agenda proposes for the world.

Keywords: Sustainable Development, University Sustainability, Education for Sustainable Development ESD, Active Learning

INTRODUCTION

On September 25, 2015, the UN General Assembly adopted the 2030 Agenda for Sustainable Development, an action plan in favor of people, planet and prosperity, which also intends to strengthen universal peace and access to justice (UN N. U., 2015).

The member states of the United Nations approved a resolution in which they recognize that the greatest challenge in the world today is the eradication of poverty and affirm that without achieving it there can be no sustainable development. The Agenda sets out 17 Goals with 169 integrated and indivisible targets covering the economic, social and environmental spheres.

The strategy seeks to guide development in the world from 2015 to 2030. By adopting it, States committed to focus their efforts, build partnerships and have the necessary structures in place to respond to the needs of the poorest, environmental protection and well-being for all: "We are resolved to end poverty and hunger worldwide by 2030, to combat inequalities within and between countries, to build peaceful, just and inclusive societies, to protect human rights and promote gender equality and the empowerment of women and girls, and to ensure the lasting protection of the planet and its natural resources" (UN N. U., 2015), the States noted in the resolution."

The 2030 Agenda sets out commitments for all global actors, to develop from each country, given the particular conditions of each one, understanding that States have full sovereignty over their potentialities and weaknesses as well as the ways of using resources to move their economy, to aprtid of the Sustainable Development Goals (SDGs), countries will propose their sustainability goals. The 17 Goals of the Agenda were developed in more than two years of public consultations, interaction with civil society and negotiations between countries (UN O. d., 2016).

In this context, the 17 SDGs seek to combat poverty, fight inequality and exclusion, achieve a peaceful world with quality of life and well-being, generating development, but framed within the limits that natural resources require for their strengthening. Today it is pointed out that there are multiple environmental situations to contemplate, to understand and intervene for the environmental well-being of the world: the biosphere, protection, conservation, restoration, use of resources, soil, water and air, regulating atmospheric affectations, ocean pollution, environmental education and citizen awareness, among many others. Environmental problems, linked to

ecological limits, require intervention at all scales, global as a common problem, regional as zonal aspects of special interest, local to intervene in communities and individual to act from the person to promote general welfare. (Caride&Meira, 2020)

Environmental management, is identified by the sequenced construction of the environmental component and commitment of society, companies, communities or simply the daily life of people. (Hernández & Amaya, 2017) Global environmental management is a circle of application environments, at a global level decisions have been made and strategies and guidelines have been formulated that seek that at a regional, local or punctual level, the least environmental deterioration is achieved, with the maximum possible human welfare. And the particular conditions of each place when applying these general guidelines, feedback experiences that allow continuous improvement of environmental management, so that by testing and learning, new scenarios of environmental respect and human and social welfare are achieved each time.

A space to achieve environmental management are the educational environments, from where the Sustainable Development Goals are articulated in different areas of knowledge and managed to be understood and adopted by citizens, to transform their attitudes aligned with the SDGs from the Technological Units of Santander, UTS, the Environmental Engineering program, in its academic approaches incorporates the SDGs as a fundamental part, so that its students know of their existence and importance, give training contexts that show how all moments of life can be contributors to achieve the SDGs worldwide achieve specific actions for global benefits.

The Sustainable Development professorship in the Environmental Engineering program at UTS is designed to allow students to articulate their technical knowledge of environmental issues, with the integral analysis of the situation and the proposal of solutions, in the moments of time, that allow communities to mitigate environmental damage and improve their well-being and living environments (Amaya, Hernandez, & Avila, 2021).

As part of the knowledge, there are the Sustainable Development Goals, but their knowledge cannot remain in the theory of their existence, but they need to be understood in the social and professional experience of students, so that their actions are framed in the global efforts to transform life for a better future. In this professorship, the principles of Education for Sustainable Development promoted by UNESCO are worked on, focusing on students so that they can identify their environment, analyze their knowledge and contextualize it, and propose solutions or interventions to avoid environmental damage and achieve sustainability in the world. (UNESCO W. C., 2020)

Taken from the introduction of the Environmental Sustainability Plan PSA, of the Technological Units of Santander (Amaya, Vargas, Hernandez, Jones, & Rodriguez, 2020): "Strengthening the Technological Units of Santander, with a solid component of environmental sustainability, seeks to contribute to the high quality with which the institution responds to the training of professionals to the region. Contributing to sustainable development should be a commitment of the institution, given its significant

influence on society, since its graduates are not only agents of specific applied knowledge, but are social actors in every instance, therefore the scope of the STSU can become significant for the integral improvement of society.

The environmental sustainability of the UTS must recognize and participate in the Sustainable Development Goals (SDGs), given that they are the global development goals that promote social inclusion and equality, the existence, respect and protection of ecosystems as givers of life, and economic balance as necessary in the social dynamics of exchange of goods and services, articulated to materialize the quality of life of all inhabitants.

For students of environmental engineering it is essential to know the approach and scope of the objectives of sustainable development, so that their analysis of the reality and construction and intervention alternatives, for recovery purposes, is aligned with the goals set at the global level and the welfare that is achieved locally, contributes to strengthen the welfare that is built globally. This makes a proactive cyclical dynamic, where global decisions guide local actions and these in turn strengthen and refocus decisions that continuously seek a better world and better living conditions for all.

The pedagogical strategy proposed seeks to guide the students of the Sustainable Development subject, so that through their own inquiry and oriented organization of the information, they manage to select the most pertinent approach to express the existence of environmental management and its progress, through moments of world history, as a support mechanism for the presentation and knowledge of the objectives of sustainable development. This knowledge of theories, the students present it organized through a graphic product, which is refined by the temporary sequenced advice of the teacher, to achieve a graphic product of technical and thematic information, with which they can make known to the communities, the world historical process and the main guidelines of the sustainable development goals.

The work bet with students seeks to promote the 17 SDGs of the UN, taking as a basis that for UTS contributes the SDG4 quality education is an institutional integral bet, so that students of all academic programs find in the educational offer, relevant aspects to the answers of different needs d society, with the academic quality of the institution, generating alternatives of life projects that improve the opportunities of its graduates. (UNESCO O. d., 2017) Betting on working the SDGs in environmental engineering students initiates the process, in which pedagogical strategies incorporate the SDGs and contribute to respond to SDG4.

MATERIALS AND METHODS

The project was built following the methodologies established by the UTS in its institutional educational model (UTS, 2020), from which active learning is proposed, student-centered (Torres, 2018) and where teaching from case analysis, project-based learning, problem-based learning, to train graduates by learning outcomes in competencies specific to each area of knowledge. This approach coincides with UNESCO's commitment to training in the Sustainable Development Goals through learning outcomes (UNESCO O. d., 2017).

The project proposed to integrate to the training process of environmental engineers, a strategy of knowledge application for the attention of social interests, in the identification of possible actions within the Sustainable Development Goals SDGs, to promote social welfare. And to propitiate a space for training among peers, for the collective construction of knowledge appropriation as a basis for the search of actions that help to improve the quality of life of the population.

The target population consisted of 120 students in their tenth semester, all of them enrolled in the Sustainable Development course. As they are enrolled in their last year of studies, they have preconceptions relevant to the SDGs, which facilitates the work of generating alternatives for intervention in reality. Taking the principle of Education for Sustainable Development (UN-UNESCO, 2019), centered on the student, by working in any of the methodologies contemplated in the UTS Institutional Educational Project, students had the possibility of finding their own process to meet the expected results.

The work began with a diagnostic survey of the students' knowledge and understanding of: environmental management, sustainable development and SDGs and their goals. This survey made it possible to identify the aspects on which to focus the training in the sustainable development course, so as to address the gaps identified. With this training working by groups of students, it would be possible to work on ways of promoting and appropriating the SDGs.

Statistically, the survey was applied to 100% of the target population, given the obligatory nature of participation due to the linkage to the professorship. It was processed by basic descriptive statistics, ranking results by average, recognizing all the results as valid, taking the most representative ones in the most repeated answers among the students.

The teacher allowed the formation of groups of up to four students, with freedom of operation. The working groups studied specific topics in depth, identified the significant points of environmental management, sustainable development and the SDGs.

In addition, a skeleton file was provided, with spaces and topics identified to guide the content to be included by the students and the conditions were provided so that the groups of students could build a graphic document like a primer, through a pre-designed power point file, with which they could transmit to their university classmates the importance and significance of the SDGs.

In the final phase, the improvement of the understanding of the SDGs in the students of the sustainable development course was evidenced through a contrast test and a base was created with 30 proposals of power point files to promote the existence of the SDGs in the UTS community and in the social community where the students would like to reach.

Table 1 shows the actions applied sequentially to execute the strategy, from the teacher's work instructions, application of the diagnostic knowledge test, definition of training topics, the content of the basic work template, fulfillment of activities and deliveries in a 16-week academic period, feedback times, application of the contrast test and final results presented by the students.

Table 1. Methodological activities of the project

Activity	Process
Activities scheduled to be carried out in a 16-week academic semester	
Diagnosticinstrument	Application of preknowledge surveys to students.
Definition and presentation of training topics	Selection of topics and concepts to be reinforced in students to achieve training in the SDGs and students' proactive work.
Guidance and follow-up on working PowerPoint template	Composition of the staff Slides 2 and 3, Historical conception of Environmental Management. Slides 4, 5 and 6, earth summits and parallel between Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). Slides 7, 8, 9, 10 and 11, presentation of the scope and actions of the Sustainable Development Goals.
Construction of the SDG presentation tool	Weeks 2 to 4. Diagnostic test and inquiry of information sources, selection and organization of concepts and theory in general to incorporate in the PPT format provided by the teacher. Weeks 5 to 7. Presentation of slides 2 to 5, organizing the information of world historical development of the environmental management and sustainable development approach, as well as the historical organization of the earth summits, existence of world and national environmental authorities and their relationship with the concept of sustainable development. Teacher feedback Week 8 to 10. Corrections of slides 2 to 5 according to teacher feedback. Presentation of slides 6 to 11 with information on the millennium goals and sustainable development goals, the latter organizing their name, definition and main goals to be achieved. Week 11 to 13. Feedback of all work and corrections, final. Delivery of complete and finished final work. Week 14. Contrast Test Week 15. Presentation of results

Source: Own elaboration

RESULTS

Recognizing that the students of the Sustainable Development course, located in the tenth semester of the Environmental Engineering curriculum, must have specific and sufficient preknowledge to understand the central themes of the pedagogical strategy, the teacher's orientation contextualizes three definitions as fundamental support of the work to be developed, the organization of the breakdown of each theme or definition and the results expected to be achieved with the students' work.

At the beginning of the development of the strategy, a closed-response survey was applied to identify the students' understanding of the topics to be addressed, the application of the topics in their training and their vision of them in their future professional performance. Table 2 shows the results of the application of the diagnostic or pre-knowledge survey to 120 students linked to the sustainable development course.

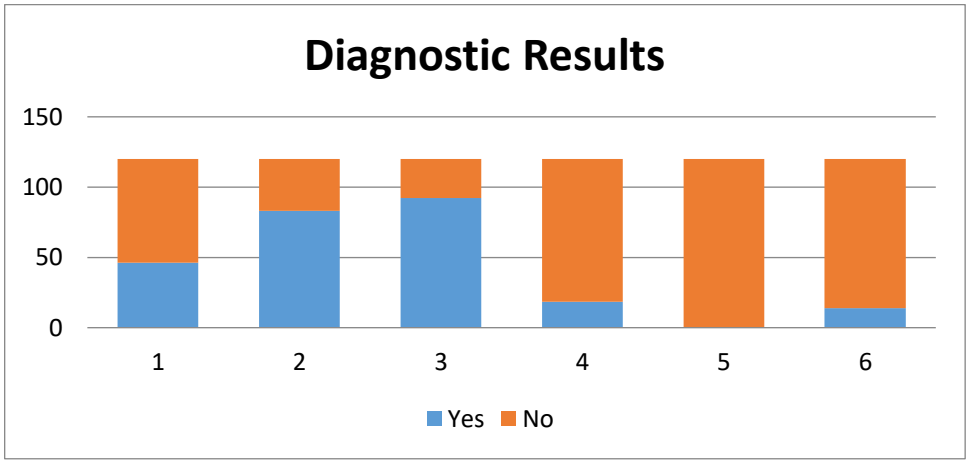
Table 2. Consolidation of responses to the pre-skills survey

DiagnosticQuestion	Yes	No
1. Do you know the contribution made by UNEP, through the Brundtland Commission in 1987, proposing to the world the definition of Sustainable Development as a guide for the integral growth of the world?	46	74
2. Have you developed in your academic training, the economic, social and environmental variables, integrated when analyzing situations of your reality of life, to describe a situation of environmental analysis?	83	37
3. In your formative academic process, have you described a problem, analyzing the direct and indirect causes that generate it, relating it to the consequences and deterioration that it has generated in the social, economic and environmental spheres?	92	28
4. In the fulfillment of their academic load, represented in the subjects to be approved to fulfill their study plan, they have worked in articulation to the global existence of Sustainable Development Goals, recognizing these as the common commitment to address the social, environmental and economic problems of the world, contemplating their causes and consequences, to propose interventions that generate partial results that together achieve the conversion of the problem in scenarios of construction of quality of life?	18	102
5. Do they know the goals proposed by the SDGs, as a strategy to comprehensively promote sustainable development strategies in a community?	0	120

6. Are you aware of the existence or implementation of strategies that comply with the sustainable development structure, to improve institutional performance and social quality of life conditions in compliance with their functions?	14	106

Source: Ownelaboration

The level of student response is visualized in the Graph 1



Graph 1. Consolidation of responses to the pre-skills survey

In the presentation of the powerpoint file as the basis for the graphic tool, the teacher focused the work within the two central themes to be known by the students: Environmental Management and Sustainable Development and within them the existence of the Sustainable Development Goals SDGs.

Environmental Management, as an explanation, two definitions are presented to guide the students:

Environmental management (GRN, 2018) can be defined as the administration and management of all human activities that influence the environment, through a set of guidelines, techniques and mechanisms that ensure the implementation of a rational and sustained environmental policy.

In simple terms, environmental management is the set of human activities aimed at the rational management of the environment. Components of environmental management: Environmental policy, environmental legislation, environmental institutions, and administrative instruments.

Environmental management (RDS, 2014) is a process aimed at solving, mitigating and/or preventing environmental problems, with the purpose of achieving sustainable development.

Sustainable development is based on the definition given by the Brundtland Commission "Development capable of meeting the needs of the present without compromising the right of future generations to meet their own needs" (Brundtland, 1987).

Based on this definition, the three fundamental elements of sustainable development are conceptualized:

Society: organization of people in different groups with their own conditions, particular to each environment and in search of their quality of life.

Economy: set of market dynamics and money that allows the exchange of goods and services to meet the needs of society.

Environment: set of natural elements that provide goods and services for market dynamics in the economy and at the service of society.

Sustainable Development Goals. (UN O. d., 2016), were promulgated and adopted by The United Nations Organization UN and its agencies UNDP and UNEP, since 2015 adopted the SDGs as a universal call to achieve three common goals: end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. Table 2 shows a nominal consolidation of the SDGs.

Table 3. Sustainable Development Goals SDGs

SUSTAINABLE DEVELOPMENT GOALS (SDG)			
	An end to poverty		Reducing inequalities
	End hunger		Sustainable communities and cities
	Health and well-being for all		Sustainable consumption and production
	Quality education		Climate action
	Gender equality		Life in the oceans
	Clean water and sanitation		Life of terrestrial ecosystems
	Affordable and sustainable energy		Peace, justice and strong institutions
	Decent work and economic growth		Partnerships to achieve the SDGs
	Industry, innovation and infrastructure		

Source: adapted from SDG UN (UN O. d., 2016).

Follow-up, to guide students assertively, the work developed in each week was sent by email for review, correction, adjustment or approval by the teacher, with which, students are fulfilling the work in parts and advanced, slow but focused, on the topics that have been proposed to know in the pedagogical strategy. Each week is scored as a

partial delivery of progress, which ensures that the final product meets the expected relevance and quality in the selection and organization of information.

It should be noted that the weekly follow-up was not mandatory as a requirement for the next week's delivery, nor for the final delivery. Although there was intermittency of the students in their weekly compliance, in general most of the students took advantage of this follow-up.

Product Delivery. At the end of the execution time and once the procedural stages were completed, each group of students handed in their proposal for a graphic instrument, designed and oriented as an organized tool to socialize the topics of environmental management and sustainable development objectives in any society.

A total of 30 powerpoint files were worked on, and the cover and some internal sections of some of the presented primers are presented below.

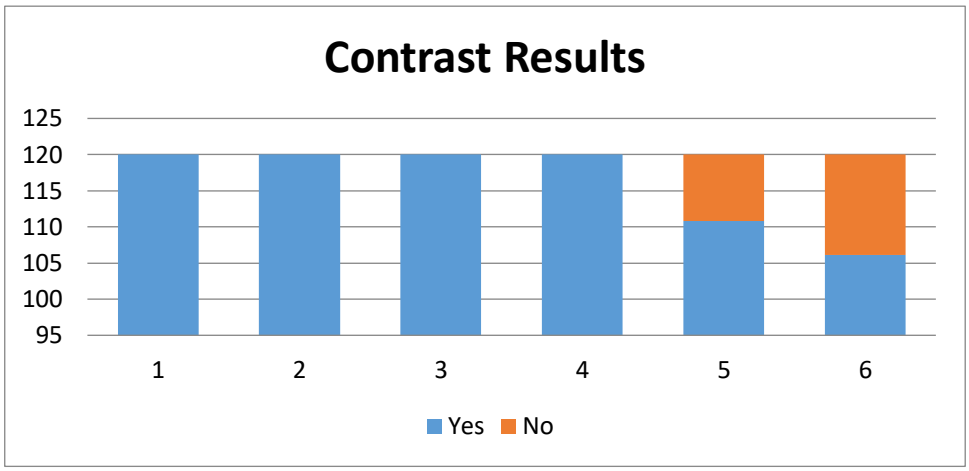
At the end of the construction of the graphic tool, a new survey was applied, with the same theme of the initial survey, but with the focus of identifying the level of appropriation and improvement of the students' knowledge of the topics developed in the strategy and their importance in their academic training and future professional development. The results are shown in Table 4

Table 4. Consolidation of responses to the contrast survey

ContrastQuestion	Yes	No
1. Have you been acquainted with the concept, dimensions and those responsible for the integration of Sustainable Development as a common goal to seek quality of life for society?	120	
2. Has the description of the economic, social and environmental variables served as a support to generate concepts that explain a situation, with the intention of intervening in search of environmental improvement?	120	
3. When interpreting or recognizing in a problematic situation, the actors and correlations of sustainability, have they allowed them to describe the situation integrally and contemplate possible alternatives for intervention?	120	
4. Have the Sustainable Development Goals provided you with criteria, concepts, or scopes focused on the economic, social and environmental aspects that must be articulated for the construction of quality of life?	120	
5. Can you propose strategies for intervention in reality that promote mechanisms for the sustainability of the quality of life of society?	111	0
6. Is it possible to strengthen STUs with economic, social, and environmental variables that can be articulated to transform their reality and build sustainable development as an institutional strength?	106	14

Source: Ownelaboration

The level of student response is visualized in the Graph 2



Graph 2. Consolidation of responses to the contrast survey

DISCUSSION

As Torres (2018) says, the research shows that the construction of a student-centered strategy, designed to promote the refection, analysis and construction of knowledge applied to reality, by the students, is an important evidence of the dedication and commitment of the teacher, with his work and with his students, to seek alternatives with which to transmit knowledge and awaken their interest in appropriating that knowledge. The elaboration of a strategy takes much more time than its preparation and evidenced execution, since it is built through the teacher, in his knowledge of the subject matter and in the discovery of the practical scope that knowledge can have in the students' lives.

The construction of an academic instrument for the purpose of communication and education to a community is a pedagogical tool that favors the appropriation of the students' knowledge, since it gives them the freedom to explore information sources, select the most relevant and organize this information in such a way that it is understandable to all readers. The programmed moments of teacher guidance and accompaniment are based on UNESCO's guidelines for education for sustainable development and take advantage of the learning objectives approach in the SDGs, given that it encourages the student to stay within the guidelines to achieve results in two ways, the most important, that the student evidences the importance of knowledge in their integral formation as a person and as a professional, and two, to facilitate the student, to find real spaces in which, the knowledge they receive in the academy, is effectively applied to consolidate benefits for a community (UN-UNESCO, 2019).

The time horizon established for the execution of the pedagogical strategy showed two contrasting situations: for the students who delivered their documents week by

week, building their documents sequentially, a more organized handling of the information and a better selection of it in its inclusion in the final delivery was recognized, which generated documents that were easy to read and that motivated them to advance in their content. On the other hand, the students who did not submit their papers, presented documents lacking structure, with decontextualized information and although they met the minimum criteria they wanted to present in the document, their organization of the information and the knowledge they wanted to present was deficient and the constructed document was not attractive for reading.

Working with a contrasting strategy, applying a diagnostic instrument and then a verification instrument, helps to support the process of monitoring and continuity of teaching and learning in the student, processes coinciding with the proposals of Caride&Meira (2020), the diagnostic instrument, applied to the group of students, through a closed survey of 6 questions, showed that to start the work, students did not have adequately contextualized information regarding environmental management and sustainable development, This, seen in the condition of being students of the last semester of the Environmental Engineering program, would not be supposed to be such a marked weakness, although the students indicate having received training for an integral vision of environmental situations, it also shows that they have not been trained in sustainability criteria nor in the existence of the Sustainable Development Goals as a tool of analysis integrated in their academic process. Even so, it should be recognized that the training they have received, allowed them to face the pedagogical strategy with minimum criteria to understand the knowledge focused on and to proceed according to the teacher's guidelines.

The Contrast instrument, shows, as expressed by Torres (2018), the importance of the teacher in assertively accompanying the training process, without losing the essence of keeping it centered on the student, not because he decides the contents to learn, but because he explores and appropriates the contents, which assertively the teacher shows him, recognizing them applied in his expectations. The contrast applied at the end of the exercise of the pedagogical strategy, to the group of students, through a closed survey of 6 questions, showed that the process did achieve the objectives set and the intentions of strengthening the knowledge of the environmental engineers of the UTS, taking sustainable development and the Sustainable Development Goals, as conceptual tools that strengthen their capacity for analysis and vision of reality, a result that coincides with the approach of education for sustainable development (UNESCO O. d., 2017). In the response, all students evidenced a strengthening of their previous knowledge and the knowledge provided in the subject and in the strategy, For all students it is clear that the analysis from sustainability is linked to the processes they develop in their training and that they will develop in their future professional performance when analyzing environmental situations of varied nature. Only for a small group of students was it not possible to demonstrate the relationship between sustainability and quality of life, and between sustainability and UTS.

CONCLUSIONS

The strategy implemented was successful in including the sustainable development goals in the final phase of the training of environmental engineers, under a practical approach that favors the appropriation of their conceptualization in future graduates, since by working under the guidelines of learning objectives of education for the SDGs, we are analyzing and reflecting on aspects of reality and above all, in words and dialogues of the trainee that strengthen that they recognize in the SDGs a tool associated with their welfare, their professional growth and their possibilities for professional growth, we are analyzing and reflecting on aspects of reality and above all, in words and dialogues of the trainee that strengthen their recognition of the SDGs as a tool associated with their wellbeing, their possibilities of professional growth and above all, articulated to the search for solutions to the problems present in their life environments.

Pedagogically, working the SDGs under active learning methodology, keeping the student at the center of the process, making him feel that he builds his knowledge, under responding to his own expectations of well-being, as stated by UNESCO in the Berlin Declaration on Education for Sustainable Development, brings education closer to people and the realities of life, with which the training of professionals evidences its proactive role in the solutions and its undeniable leading role for a better future for all. The comparison between the diagnostic and contrast answers of the participating students shows that working by learning objectives, with active learning methodology, does generate results and strengthens the appropriation of knowledge in the student, because it recognizes its representativeness not only in their academic process, but also a real application in their expectations and solutions to life needs.

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