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Artículos científicos

Modelo para la concientización ambiental basado en la contextualización en la educación medio superior

Model for environmental awareness based on contextualization in high school education

Modelo de consciência ambiental baseado na contextualização no ensino superior

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Resumen

La concientización ambiental es un inherente al pensar en mejorar la situación medioambiental, por ende, es necesario incorporar sectores que cuentan con conocimientos que pueden ser aprovechados para desarrollar integralmente al individuo en relación con su entorno. Trayendo consigo pensar en el sistema educativo para este fin, teniendo como objetivos principales, relacionar los distintos tipos de conocimiento con necesidades presentes en la vida cotidiana del estudiante, de tal manera que pueda ir dinámica y gradualmente concientizando el impacto de su actuar en el ambiente.

Para lo anterior se utilizó el modelo para la concientización ambiental basado en la contextualización, fundamentada en las fases de la concientización ambiental por las que transita una persona, los componentes de la educación ambiental, los seis niveles para poder formar las habilidades necesarias para cimentar el pensamiento crítico y el modelo ERCA. Esta investigación es una etapa de un proceso heurístico, teniendo su primera implementación

en la Escuela Nacional Colegio de Ciencias y Humanidades Plantel Vallejo, en una población total de 240 y 452 alumnos para el periodo 2021 y 2022 respectivamente, correspondientes a estudiantes de la materia de Física. Obteniendo con su implementación materiales basados en el modelo constructivista y la taxonomía de Bloom que son la esencia de la institución, pero correlacionando los aprendizajes con situaciones contextualizadas. Logrando con ello una disminución del 20% en el índice de reprobación de la asignatura de Física, una reducción promedia mínima del 2.15% del consumo energético domiciliario, y un incremento en la participación en eventos científicos.

Palabras clave: educación ambiental, aprendizaje, ciencias, concientización, contextualización.

Abstract

Environmental awareness is inherent when thinking about improving the environmental situation, therefore, it is necessary to incorporate sectors that have knowledge that can be used to fully develop the individual in relation to their environment. Bringing with it to think about the educational system for this purpose, having as main objectives, to relate the different types of knowledge with needs present in the daily life of the student, in such a way that it can be dynamically and gradually becoming aware of the impact of its actions in the environment.

For the above, the model for environmental awareness based on contextualization was used, based on the phases of environmental awareness through which a person passes, the components of environmental education, the six levels to be able to form the necessary skills to cement the critical thinking and the ERCA model. This research is a stage of a heuristic process, having its first implementation at the Escuela Nacional Colegio de Ciencias y Humanidades campus Vallejo, in a total population of 240 and 452 students for the period 2021 and 2022 respectively, corresponding to students of the subject of Physical. Obtaining with its implementation materials based on the constructivist model and Bloom's taxonomy that are the essence of the institution but correlating learning with contextualized situations. Achieving with this a 20% decrease in the failure rate of the Physics subject, a minimum average reduction of 2.15% in home energy consumption, and an increase in participation in scientific events.

Keywords: environmental education, learning, sciences, awareness, contextualization.

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Resumo

A consciência ambiental é inerente ao pensar em melhorar a situação ambiental, portanto, é necessário incorporar setores que possuam conhecimentos que possam ser utilizados para desenvolver plenamente o indivíduo em relação ao seu meio. Trazendo consigo pensar o sistema educacional para esse fim, tendo como objetivos principais, relacionar os diversos tipos de conhecimento com necessidades presentes no cotidiano do aluno, de forma que ele possa ir se conscientizando de forma dinâmica e gradativa o impacto de suas ações no meio ambiente.

Para o exposto, foi utilizado o modelo de consciência ambiental baseado na contextualização, com base nas fases de consciência ambiental pelas quais uma pessoa passa, os componentes da educação ambiental, os seis níveis para poder formar as habilidades necessárias para cimentar o pensamento crítico e o modelo ERCA. Esta pesquisa é uma etapa de um processo heurístico, tendo sua primeira implementação na Escuela Nacional Colegio de Ciencias y Humanidades Plantel Vallejo, em uma população total de 240 e 452 alunos para o período de 2021 e 2022 respectivamente, correspondendo a alunos da disciplina de Físico. Obtendo com sua implementação materiais baseados no modelo construtivista e na taxonomia de Bloom que são a essência da instituição, mas correlacionando o aprendizado com situações contextualizadas. Conseguindo com isso uma diminuição de 20% na taxa de reprovação da disciplina de Física, uma redução média mínima de 2,15% no consumo de energia doméstica e um aumento na participação em eventos científicos.

Palavras-chave: educação ambiental, aprendizagem, ciência, conscientização, contextualização.

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Introduction

Education is a process that takes time to achieve significant learning, requiring going through different cognitive levels that, in correlation with the culture and personal aspects of individuals, admits a social transformation. Being this essential ideal a way to be able to generate a viable change in the face of environmental conflicts, not only creating awareness, but also facilitating the training space for people intrinsically aware of environmental damage and with the possibility of solving problems in this regard (Strobl, 2005; Pérez, Pérez and Quijano, 2009; Juyent & Kong, 2011, cited by Fuentealba and Soto, 2016, p. 449). Being an indispensable task, to broaden the bases of a well-informed public opinion and of individual

and collective behavior, inspired by the sense of their responsibility regarding the protection and improvement of the environment in all its human dimension (Román and Cuesta, 2016 , p.26), based on a moral regulation that requires the commitment of all citizens, where the well-being between society and nature is sought (Navea, 2018)

Generating a social change is complex, since each human being has thoughts and problems related to their environment, coupled with this, the educational sector requires a reformulation of all the actors and their plans to be able to follow this objective in a formal way. This is not unfavorable at all levels, since when we are talking about "environmental conflicts", being such a broad field it contemplates different needs present in society, which can serve as a motivator for the main actor to want to know more and with greater depth of the themes that correlate with what you are experiencing; and coupled with the fact that currently many educational institutions in Mexico are incorporating the Sustainable Development Goals or Global Goals of the United Nations into their work, it can be possible to link the themes with the current context through which the student travels, thus achieving the synergy between significant knowledge and the tools available to the teacher to achieve these goals.

Meaningful learning refers to the phases (Table 1) through which humans go through to acquire and store ideas and information from the different fields of knowledge. Which always leads to questioning whether what is evaluated is not by memorization, so it is necessary to ask questions and problems that are new and unknown, so that they require the highest level of transformation of existing knowledge (Ausubel, Novak, and Hanesian , 1976). Offering the framework for the design of metacognitive tools that admit knowing the organization of the learner's cognitive structure, that is to say, it will be possible to know the student in a better way and with it start from the experiences and knowledge that he possesses (anchoring) to be taken advantage of. for your benefit, with a view to connecting you with new knowledge (Ausubel,1983).

Table 1. Phases to achieve significant learning.

Phases of significant learning		
Initial	Intermediate	Final
• Conceptually isolated information. • Learning by accumulation. • Global procedure (specific knowledge, general strategies, knowledge of another domain). • Concrete information linked to a specific context. • Verbal learning. • Mnemonics. • Prior knowledge. • Analogies.	• Formation of structure from isolated pieces of information. • Deeper understanding. • Application of contents in different situations. • Reflective feedback. • Cognitive mapping.	• Greater control of situations. • Execution of contents in a natural way. • Accumulation of new knowledge (mastery). • Increased levels of interrelation between schema elements.

Source: Compilation based on Muñoz (2004)

In the words of González and Arias (2017) "in the Mexican context, it was biologists and ecologists who gave the first voices of alarm about environmental conflicts and who began to implement educational programs to address the problem" (p.57), that have been insufficient in the face of this environmental-social conflict, since it is estimated that 78% of Mexicans have little or no interest in the environment and do not take action (Natalichio, 2019), highlighting the need for a pragmatic change in the face of this situation, due to the fact that by 2050 there will be 10,000 million inhabitants on Earth, and of these, 90% will live in developing countries, and only 10% will reside in industrialized countries, so if If you are not aware of the factors that influence this global problem, you will not be able to find a solution (Carmona, 2020).

What highlights the need to train individuals with greater environmental responsibility, since the energy consumption of each person depends directly on their behavior, requiring promoting changes in individual attitudes (Reina, Labrada and Oduardo, 2020). Reclaiming an environmental literacy that demands: knowledge of the environmental reality and the identification of its problems, understanding of social, historical and ecological processes, the development of environmental sensitivity and the search for available solutions and means of action (Secretary of Environment and Natural Resources [SEMARNAT], 2020). That promotes educating true human beings, with a critical conscience, values,

environmental citizenship; professionals who are active in the face of biodiversity degradation and know how to build a socially harmonious society (Sepúlveda, 2020).

However, due to the culture of its population and weak national legislation, despite the fact that Mexico is an exceptionally privileged country in biological terms, its ecosystems and those who live in them are in constant risk, since destructive environmental public policies are applied that have serious repercussions on the health of Mexicans and on the environment, such as (Santana, 2020):

- The alarming reduction of the environmental budget. Such as the 75% cut in the operating expenses of the Commission for Natural Protected Areas (CONANP), which makes it impossible for the government to fulfill its function of protecting nature, controlling pollution and operating sustainable rural development projects.
- The federal government's refusal to update Mexico's Climate Change Strategy and Regulations, and the withdrawal of support, incentives, and budget to achieve the transition to renewable energy production.
- The lack of a long-term vision to meet the needs of present and future generations when implementing projects that may undermine the protection of forests and ecosystems.

Given this scenario, on October 21, World Energy Saving Day 2020 was celebrated, an outstanding date within the environmental calendar, since it originated with the aim of raising awareness among the population of the importance of saving energy to reduce its carbon footprint. on the planet (Yáñez, 2020). Being an essential task at this time where activities at home increased due to the COVID-19 pandemic, requiring in this new reality, regulating home energy consumption that, in addition to helping to reduce GHGs, contributes one of the most easy to save money (Lizárraga, 2020). That contrary to what was thought to happen with this pandemic outbreak, having a delay in the urgency of the climate change crisis and the need for environmental actions, an approach of the population was obtained due to the correlation that this problem has with the type of current diseases.

With a view to this fact, a circle of reflection was carried out in Mexico City (CDMX), with the purpose that experts in the subject establish axes to improve the current environmental situation. That resulted in the search for a legislative restructuring aimed at maintaining a balance in the actions of the human being with its ecosystem; and the obligation to incorporate society in this area, making them more aware of this event in order to maintain future resource security.

Requiring, therefore, causing the population to go from being informed to being aware of the environment. Environmental awareness can be understood as a philosophy of life that cares about the environment, guaranteeing a balance in the present and the future (United Nations High Commissioner for Refugees [UNHCR], 2018); with the aim of promoting from four dimensions: cognitive, affective, conative and active (Table 2), that the population adopt sustainable practices that make them responsible for the footprint in the ecosystem caused by their lifestyle (Jiménez and Lafuente, 2007, cited by Tonello and Valladares, 2015; Díaz and Fuentes, 2018; Canneti, 2020).

It is important to define environmental awareness based on three basic principles: the protection of the environment and each of its elements, the preservation of ecosystems and their biodiversity, and the promotion of responsible attitudes towards nature (Twenergy, 2020). Which can be promoted in two ways; from school, through environmental education exercises for the beginning student and through initiatives to raise awareness about the consequences that personal actions can have on the environment (ACNUR, 2018).

Table 2. Dimensions of environmental consciousness.

Dimensions of environmental consciousness	
Cognitive (Knowledge)	
Ideas and their degree of understanding are discussed.	Category of information and understanding of issues related to the environment.
Affecting (Attitudinal)	
It reflects citizens' feelings and concerns about the state of the environment.	Perception of the environment; environmental beliefs and feelings.
Conative (Dispositional)	
We speak of attitudes, encompassing the disposition of citizens and the scope of environmental policies.	Willingness to adapt pro-environmental criteria in behavior, showing interest or predisposition to participate in activities and contribute to improvements.
Active (Behavioral)	
We talk about behavior from an integral approach.	Performance of environmentally responsible actions and behavior, both individually and collectively.

Source: Compilation based on Monayo (2018) & Santacruz (2018)

Methodology

The system has the purpose of seeking environmental awareness in the population, starting with the educational sector, since they, being in a process of integral development, have tools and knowledge that help them correlate their actions and their impact on their environment.

more plausibly, in addition to this, it must be remembered that the problem is not temporary, so it is necessary that the new generations begin to be more sensitive on the subject if the expected situation is really to be lessened. In such a way that the proposal is intended to meet the following objectives:

- Relate the previous and acquired knowledge of the actors with needs or contextual applications.
- Make the population aware of environmental problems and what role they play.
- Design spaces and/or actions for the actors to argue feasible alternatives to improve the conditions of their current environment.

Based on this, the adaptive methodology to the context used (Table 3) for the research and planning process of the alternatives to improve the current situation of the problem under study allows the researcher to correlate their needs and particular interests or the context and modify it. before the scenarios that arise in a flexible and dynamic way. Next, the organization of the steps and sub-steps that are suggested to be followed before the problem under study is shown in a global way.

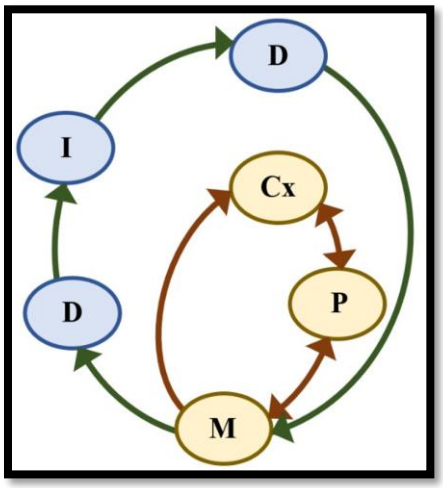
Table 3. Stages and sub-stages of the context-adaptive methodology.

Methodology adapted to the context
Context and state of the art (Cx)
C1) Definition and justification of the project. C2) Context and state of the art research. C3) Bibliographic research of practical and/or theoretical solutions. C4) Compilation of the most relevant factors of the system.
Problematic (P)
P1) Define the unmet needs. P2) Problem formulation. P3) Hierarchical integral systemic diagnosis of the situation of the relevant problems.
Modeling (M)
M1) System objectives. M2) Definition of feasible desirable changes. M3) Documenting the rejected alternatives. M4) Building the model. M5) List the functions of the model. M6) Compare the model theoretically with the objectives.
Documentation (D)
D1) Preparation of the plan. D2) Elaboration of program.
Implementation (I)
I1) Action to solve the problem or improve the situation. I2) Diagnose the alternatives that can be adjusted from the implementation process.
Operation and improvement (O)
O1) Evaluate and diagnose the impact of the proposal. O2) Retrospective assessment. O3) Improved operation. O4) Development of a growth and improvement program.

Source: Own elaboration.

Figure 1 shows the relationships between the different stages of the methodology. Starting from the justification, the delimitation of the border and the collection of information (Context and state of the art) that cement a deep knowledge of the system and its most relevant factors. So that, based on this, the problem and unresolved needs can be defined, in order to systematically and comprehensively diagnose the most relevant conflict situations and rank them in favor of their importance (Problem). These two steps maintain constant feedback, since the previous investigation will establish the limits and scope of the problem situation, but in the event that this second stage finds factors not initially contemplated, it will require that the information obtained be reassessed. This is essential, since there is a dynamic system where its different actors maintain a broad relationship with their context.

Figure 1. Methodology adapted to the context.



Source: Own elaboration.

When the previous condition is met, the actions to be taken are specified, for this the objectives pursued by the system are outlined and the facts, alternatives and criteria that validate the satisfaction of what is proposed are established (Modeling). The steps corresponding to the action stage maintain a linear sequence, designed to provide feedback on everything that was projected. For this, the stipulated agreements that support the implementation of actions that improve the current situation are first documented and alternatives that favor facilitating this process in future applications are previewed. Finishing with the operation and improvement of the system that corresponds to the prospective of the system and assessment of compliance with what was planned.

This last step is linked to the third (Modeling) so that it allows evaluating if the model covers the objectives and unresolved needs raised; or if what is not being fulfilled was discarded in the first instance or was not contemplated and the current proposition must be restructured. The control of the system is complex as it is subject to the change in the habits and customs of society, for which a formative evaluation of the results must be carried out, since it has the objective of guiding, regulating and motivating the individual to throughout the process; Since as long as he sees tangible results, he will continue with the initiative of wanting to learn and apply what he has acquired.

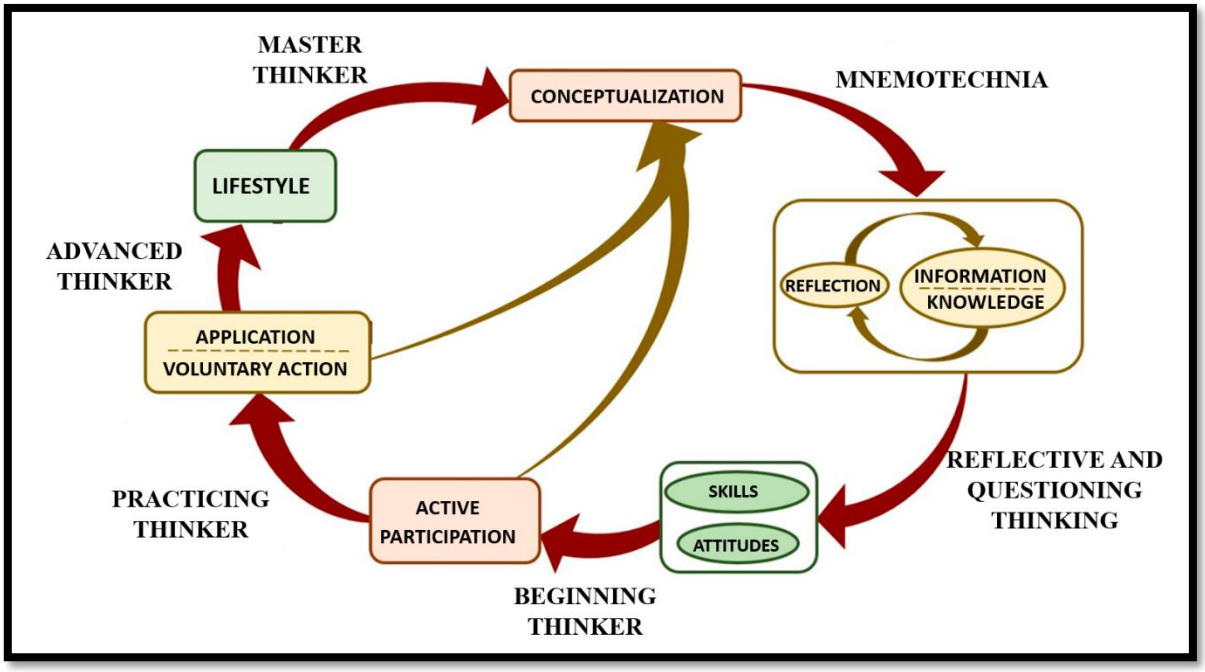
Model

Considering the needs of the system and its study, the model for environmental awareness based on the contextualization proposed to address the problem in studies was designed, which is based on the phases of environmental awareness that a person goes through (sensitization -motivation, knowledge-information, experimentation, interaction, developed capacities, assessment-commitment, voluntary action-participation), the components of environmental education (awareness and sensitization, knowledge and understanding, attitudes, skills, and participation), the ERCA model (Experience, Reflection, Conceptualization and Application), and the six levels to be able to form the necessary skills to build critical thinking (reflective thinking, questioned thinker, beginner thinker, practicing thinker, advanced thinker and master thinker).

The ERCA model assumes that each training unit is made up of a complete cycle in which learning is directed on the basis of their previous experience and their reflection on it, making an abstraction and acting accordingly, moving on to the next unit whose point The beginning is, again, the previous experience. In such a way that he plans a sequence of activities that begins with an exploratory stage, which involves the manipulation of specific materials, and then continues with activities that facilitate conceptual development based on the experiences gathered during the exploration. Then, activities are developed to apply and evaluate the understanding of these concepts (Rodríguez, García, & Ibarra, 2013; Pico, 2011, cited by Monroy, 2019).

For their part, the levels for the development of critical thinking are based on the idea that everyone thinks, but much of thinking by itself is arbitrary, distorted, biased, uninformed, or prejudiced. However, the quality of life and what is produced, done or built depends precisely on the quality of thought. In such a way that excellence in thought must be exercised in a systemic way in order to be able to deliberately use mental resources for the purpose or goal of understanding, explaining, deciding or creating something; that is to say, guide him to the solution of problems and the making of efficient and effective decisions (Paul y Elder, 2003; Villarini, 2003).

Figure 2. Contextualization-based model for environmental awareness-raising.



Source: Own elaboration.

The model (Figure 2) starts from the conceptualization that takes into account the need for the basic concepts required for the student to have tools with which to contrast the knowledge acquired and their experiences, in order to reach a higher cognitive level. Even though mnemonics is often stigmatized in the teaching process, memorizing is also useful for thinking, making decisions, and thus solving problems. However, it is necessary to delimit when memorization is pertinent and when it is not; which means that it is a systemic triad that leads to understanding the need to study not only isolated parts and processes, but also to solve problems as a whole. Therefore, an educational action aimed at transmitting content with the support of this technique must take into account: that the pedagogical action has to respond with successful alternatives that facilitate the approach to the complicated reality, propose didactic alternatives to obtain knowledge, convert the classroom in the center of discussion and debate, and overcome information reproduction schemes through initiatives that stimulate creativity, criticality and innovation.

To verify the value of the proposed model, an initial implementation was carried out at the Escuela Nacional Colegio de Ciencias y Humanidades (ENCCH) Vallejo campus, since one of the distinctive characteristics of the ENCCH from other baccalaureates is its educational model (constructivist) due to to its comprehensive approach; which contemplates a basic culture, propaedeutic and oriented to the ethical and social intellectual formation of its

students (ENCCH, 2018), leaving the legacies of learning to learn, learning to do and learning to be (González y García, 2013).

As Díaz and Hernández (2010) mentions, a constructivist approach tries to combine the how and what of teaching, its central idea being teaching to think and act on significant and contextualized content. Therefore, the teacher must propose the necessary tools to achieve the expected learning in relation to the proposed cognitive level. In order for the student to learn, learn and study (González and García, 2013). Therefore, the learning proposed in the study programs of the ENCCH is based on Bloom's taxonomy, which allows the ordering and hierarchical classification of educational objectives based on the complexity of the cognitive process, starting from the simple to the complex (Anaya, 2019; Parra and Musical, 2017).

These cognitive levels are implicitly considered by the model for environmental awareness based on contextualization: knowing, understanding, applying, analyzing, evaluating, and creating. As noted, the degree of complexity will increase and, since it will first be directed to the area of experimental sciences, particularly in the field of physics, for which the actions to solve the problem or improve the situation are framed in Table 4.

The purpose of correlating the themes and the problem under study is to take advantage of the constructivist model and Bloom's taxonomy with which the study programs of the College of Sciences and Humanities are based, which are intended to generate sequential activities to better cement higher order cognitive levels; In addition to this, it seeks to generate comprehensive and interdisciplinary training so that they can apply their practical and theoretical knowledge in solving problems; however, one of its main drawbacks is that it does not take contextualization into account in aspects that are easy for students to correlate with their new knowledge and their daily lives.

Table 4. Contextualized actions to build learning gradually.

Action	Research question
Correlation between the topics and the problem under study	What is the cognitive level that young people between 15 and 17 years of age possess in environmental terms?
Action to make a comparison that allows a generalized breakdown of the students' prior knowledge, to have a basis with which to create materials with which to cement the expected learning in the subject but correlating them with what they are interested in and/or live day by day.	
Creation of materials related to the problem under study.	What digital platforms exist and are they suitable for high school students?
With the most relevant factors in mind, the methodology and method used to address the problem, the creation of different digital and/or physical materials aimed at informing and generating debates on topics of the mathematical physics area and its contextual application is carried out.	
Course "My impact on the environment"	How much does the study population know about its impact on the environment?
In this stage, topics that interested students already know about are correlated and scenarios with needs to be improved are proposed to them, in addition to inviting experts in different areas of knowledge to talk about the topic in depth and thus have a broader perspective on the sector they are most interested in studying.	
How much electrical energy do I consume?	What is the benefit and cost-effectiveness of implementing the system?
For students to understand and become aware that their actions have an impact on the environment, participants were first instructed on how they can identify the elements of their electricity bill and perceive what each of the data presented therein refers to, and then relate it to their ecological footprint.	
Physics workbook contextualizing it to the problem under study.	How can the knowledge necessary to improve environmental awareness be founded?
Elaboration of a workbook in accordance with the ENCCH Physics syllabus, with the purpose of contextualizing learning so that the actor understands both the electrical analysis carried out in the application of electricity consumption measurement and the problems generated by the ecological footprint caused by his actions.	
Design of an energy meter	How profitable is it to implement the system?
Activity for students to integrate practice and theory of elements that they studied interdisciplinary, to create a wireless energy consumption meter that shows them the expenditure of their home and feedback their new act.	

Source: Own elaboration.

In order to compare the above with the objects raised in the project, the diagnostic, formative and summative evaluation was used based on the cognitive levels proposed by Bloom's taxonomy, where the activities were categorized in stages that allowed the acquisition of knowledge of the simple to complex in three moments: initial (detection), development (process), and final (achievement) (Muñoz, 2004). To achieve the above, the techniques, procedures, and instruments of evaluation of significant learning were used, which are

divided into observational (systematic, non-systematic), student production (oral, written, graphic and practical representations), and intercommunication (Face to Face, group) (Salazar, 2018).

In this way, in order to diagnose the achievements obtained, self-evaluation, peer-evaluation and hetero-evaluation were used; Through instruments such as: checklist, reports, questionnaire, class notebook, interrogation, debates, written exams, generation of questions, conceptual and mental maps, models, drawings and graphs, projects, case method, interviews, colloquia. Of which both the final products were evaluated by scaling the quality of what was presented, as well as the progress obtained, the language used, the degree of interconnections between their knowledge and the context under study, their capacity for reflection and self-criticism, values for the work in team and debate, as well as the ability to explain problems from their own words. All this collected in materials designed in relation to the CCH Vallejo study program in workbooks, with which it will be possible to have a tangible retrospective of the learning achieved in the students.

Given this, one of the main aspects to consider when creating a strategy, for this reason, is to understand which are the most relevant factors to consider in order to take them into account when designing the materials and thus be able to foresee how these activities can be adapted to different scenarios, since being in an open system such as education, their different ways of thinking, habits, customs, beliefs, among other elements, are something that will affect the motivation that the individual or group of actors will have for wanting to address the proposed materials . In this way, in the first instance it is necessary to understand what is the cognitive level that they present regarding environmental issues, what are the concepts that are difficult for them, and if they have something in particular that catches their attention, since with these elements they can go generating progressive activities that start from the simple to the complex to cement the expected knowledge and that begin to relate learning and experiences that they already handle with what they will acquire during their training process.

In order to create the necessary materials that meet the proposed objectives in search of environmental awareness, a form was created on the Microsoft Forms platform due to its compatibility with Teams, which allows only the desired student population to answer it. This previous activity is intended to visualize the level of understanding that young people have of environmental problems and the importance of what they have learned in Physics. It should be clarified that the questions proposed in this activity follow the essence of the

project, that from a friendly language young people can define and explain physical phenomena and ecological needs.

Based on the previous premise and the current situation of the SAR-CoV pandemic, digital and printed materials were designed so that the selected space is suitable and accessible for the majority of the student population, for this reason it was chosen to use digital platforms. following, YouTube, Facebook and Teams, which will serve as a repository and are free for both the creator and the end user.

In addition, one of the advantages obtained by having these digital media is that the space can be regulated in the first instance so that it is suitable for the research activity and later it can be managed so that a larger population or the general public can commenting on the conclusions reached by the students, this allows them to have a greater perspective of the factors that affect the system and if they really considered it in their analysis, if it is viable or if it is necessary to restructure their main idea. Since the objective of creating this type of space, apart from seeking to improve environmental awareness, is to fully develop the actors, in such a way that they can link both practical and theoretical knowledge, without neglecting cultural aspects and the context in general. that influences the perspective of a system.

In order to see the value and strengthen the proposals, an implementation was made to a non-probabilistic sample that had a total population of 240 students in the 2021 period and 452 students for the 2022 cycle, corresponding to third, fourth and fifth grade groups. semester of the College of Sciences and Humanities Campus Vallejo. In this, topics that they already handle were correlated and scenarios with needs to improve were proposed to them, in addition experts in different areas of knowledge were invited to speak from their experience and thus have a broader perspective and see what the sector is. What most attracts your attention and how you can improve the current conditions of that system; Because with this they will be able to realize that all environmental problems are linked to each other, so there are no individual solutions if the consequences that their actions will cause in the other systems with which they are related must not be foreseen. In this way, the goal of the course is for students to achieve the expected learning meanings, develop their abilities to forge critical thinking, as well as attitudes and values for debate, and feedback both in groups and individually.

In order to put what they have learned to the test, students were asked to be more aware of their impact by understanding how much electrical energy consumption their home generates, for which in the first instance they were instructed how to properly read their

electricity bill, so that with This identifies which are the variables that intervene in the collection made by the Federal Electricity Commission, in order to diagnose if with the new knowledge acquired they can take actions aimed at minimizing the impact caused by their actions. In addition to this, to generate a motivator so that they want to learn more and better about these topics, they are explained how the variability of the cost/kilowatt hour influences, and how to be able to optimize to avoid peak hours where the price is higher and thus continue saving. In economic terms

For students to understand how their receipt works is very important as some specific values will have dynamic variations such as; the price of the cost of kilowatt-hours (kWh) which will feed back what they learned from these variables in the topics of the Physics subject and contemplate the difference between ideal theoretical scenarios and real life, which will make them reflect on what factors were discarded and how they can implement them if they want to make a more detailed analysis, as well as question what other phenomena studied present this limitation; in other words they comprise the different levels of knowledge.

For this process, they were asked to download their electricity bills for the year in order to have a record of bimonthly consumption for 2020-2022, and if they considered it appropriate, they were asked to place said document in a shared folder on the Teams platform. Using the same platform, they were assigned an activity for which they will enter recurringly and fill in the data of their electricity expense, as well as the receipt.

These data allowed us to obtain a constant evaluation of whether the knowledge acquired by the students had a positive effect or not on their electricity consumption and were related to allusive examples of what this change meant month by month to make it more affable than the young people did. They will relate to something they know, such as how much this decrease in Greenhouse Gas Generations, in hydrocarbon consumption or in money is equivalent to.

In order to document all these adaptations and incorporations to the themes of the Physics study program of the ENCCH, a workbook was created that has the purpose of contextualizing the learning so that the actor understands the materials designed in previous stages, as well as the project to evaluate their electricity consumption, as well as in problems generated by the ecological footprint that their actions cause; This activity is complementary to the previous ones, likewise a section is placed where the teacher can see suggestions on how to adjust the material in question to the present needs of the group. Thus being able to facilitate the correlation of the different types of knowledge (epistemological, ontological

and cultural) and thereby better cement the base of knowledge that they will require both for their other subjects and for the situations that arise.

Given this goal, the data from the Academic Diagnostic Exam (EDA) was reviewed, which is an internal instrument used in the College of Sciences and Humanities and whose objective is to evaluate the achievement of learning of the subjects of the Study Plan. In this way, with the creation of this material, firstly, it seeks to generate a more environmental awareness in the population under study without straying from the learning and cognitive levels proposed by the College and secondly, to have an example of how a subject can be contextualized in order to transfer it to more areas of knowledge by experts in the matter in question.

Finally, understanding that the activities are aimed at reducing home energy consumption by making individuals aware of their impact on the environment, the development of a simple home electrical energy consumption meter is proposed by means of electronic components studied in the units of electromagnetism of matter and that is progressively analyzed in the work booklet created to make it easier to understand. This, in addition to motivating them by being able to put what they have learned into practice and see how their integration creates something new and more complex with which they are more technologically accustomed; It allows them to understand how the absence of a variable such as the decrease in energy expenditure is valued, which entails obtaining higher order knowledge.

Results

One of the initial premises of the project and that the experts mention; It is that the current generations are more aware that environmental problems exist and are more sensitive to them, since they were born when they were already present and have experienced them firsthand. However, the majority of the population are at the basic levels, since they still cannot explain it clearly, they confuse the concepts, they do not find the relationships between factors, they try to take care of their consumption, but they do not know how to do it correctly. Reflecting that their intentions are good, but they lack the tools and actions that support them in their perspective of the world.

This fact could be verified with the results obtained from the diagnostic activity implemented to the non-probabilistic sample of 240 students under study, which aims to understand the basic concepts of this topic, as well as what actions they know to minimize their ecological footprint, yielding the following data:

- 40% of students do not consider that the subject of Physics has any impact on their lives.
- 54% do not know what the energy consumption of their house is, and the same number indicates that they do not know how to read the power of electrical equipment.
- 52% mention that they do not know how to interpret an electricity bill and 60% indicate that they are unaware of the factors they consider when charging for this service.
- A favorable perspective is that only 26% do not recognize energy-saving equipment, a percentage that is repeated with the implementation of incandescent lamps in their homes; while 34% have LED lamps, 38% energy-saving lamps and 2% indicate another type.
- 82% mention that they try to save electricity, but 77% do not know what phantom consumption is.
- 72% know how electricity is generated, indicating 66% that this activity contaminates the environment, while only 3% do not believe that it does and the rest mention that they cannot decline for any of the answers.
- 55% know what renewable energies are, 42% indicate that they have heard about them, but do not really know what they are, and 3% have never heard about them.
- 45% believe that Mexico does implement renewable energy in its matrix, but only 26% believe that the country does support this type of project.
- 98% and 96% indicate that they know or have heard about global warming and the greenhouse effect, respectively. But 32% do not know how to differentiate these terms.
- On a scale of 1 to 10, they consider it very important (9.63) to address the issue of global warming.
- 63% know someone who is interested in environmental issues, expressing that for 70% it is essential to understand this type of problem, 15% believe that it is relevant, but only from time to time, and the rest mention that they are interested. when they see, read or hear it in any medium.
- 76% have seen the causes of the greenhouse effect at school, mainly in the subjects of biology and chemistry. 21% have done it on their own and 3% mention that they had never heard of it.

- Among the most common ideas of those who understand global warming and what impact it has is: the increase in the temperature/heat of the planet, the melting of the poles and glaciers, scarcity of resources, a consequence of man for his actions, a disorder of the natural balance, and which drives the degree of natural disasters.

In conception of the aforementioned results and based on the model for environmental awareness based on contextualization, we proceeded to carry out proposals with which the various units of the study programs of the subject of Physics of the ENCCH can be addressed. (Table 5), for this, a more centralized perspective of how the theory works was proposed, and what impact both its application and the actor's actions have in their environment, taking into account the cognitive levels of Bloom's taxonomy; thus, obtaining a 73% correlation between environmental problems and the subjects of the subject under study.

Table 5. Example of a proposal for the contextualized study of the topics of the Physics II syllabus of the ENCCH.

Program of Physics II		
Unit 1. Electromagnetism principles and applications		
Cognitive level	Thematic	Proposal for study
Remember	Electric charge	Correlation with the Law of Universal Gravitation
Remember	Forms of electrification	
Understand	Conservation of electric charge	
Understand	Electrostatic interaction and Coulomb's law	
Understand	Intensity, direction and direction of the electric field in a point	
Understand	Electric field over two parallel charges and plates.	Capacitors
Understand	Work and energy	Simple machines.
Understand	Direct electric current and voltage	Electric energy in the home.
Understand	Electrical resistance	Resistance of the human body and equipment.
Apply	Ohm's Law and circuits.	Electronics and their contaminants.
Apply	Electrical power.	How do you charge for electric power service?
Understand	Transformation of electrical energy and Joule effect.	The efficiency of heating equipment.
Remember	Use of electrical energy in the home and community, hygiene and safety measures.	Phantom consumption and energy efficiency.
Remember	General properties of magnets and terrestrial magnetism.	Compass and its relation to the Earth.
Remember	Magnetic field and field lines.	

Program of Physics II		
Unit 1. Electromagnetism principles and applications		
Cognitive level	Thematic	Proposal for study
Remember	Relation between electricity and magnetism.	Motors, generators and alternators.
Understand	Magnetic field generated around a straight conductor, loop, bonina.	
Remember	Magnetic interaction between magnets and coils.	
Understand	Mechanical energy transformation.	Electric power generation.
Remember	Electric current generated by magnetic fields.	
Understand	Electric generator.	
Unit 2. Waves: mechanical and electromagnetic		
Remember	Characteristics of a wave	The greenhouse effect and climate change
Understand	Types of waves	
Aplicación	Sound and light	
Understand	Waves and particles	
Understand	Wave energy	
Understand	Wave phenomena	
Understand	Sound and electromagnetic spectrum	Noise and visual pollution.
Understand	Applications of wave studies	
Unit 3. Introduction to modern physics		Nuclear energy generation and consequences.

Source: Own elaboration.

In this way, basing the previous proposal, more than 40 videos were created using digital drawing and video editing tools, such as; XP-Pen Artist 22 pro, Microsoft Whiteboard, Adobe Photoshop, Vegas Pro and digital platforms like YouTube; with durations that range from 30 to 80 minutes posted on the FISCCH YouTube channel and that to date have more than 13.9 thousand views and 164.4 thousand impressions from both the study population and the general population.

Said material, being directed to the Physics study programs of the College of Sciences and Humanities, maintains as a base the cognitive levels proposed by it (knowledge, comprehension and application), but exceeds them by seeking that the young person can explain what is global warming, its relationships (analyze, evaluate) and propose alternatives to solve the problems that this phenomenon entails, going through the different stages of the thinker (beginner, in practice, advanced and master).

Regarding the above, students were invited to an extra course-workshop called "My impact on the environment", to study climate change in greater detail, its elements, correlations, effects, alternatives to improve the situation and what is their role in the face of this problem.

The meetings began on March 4, 2020, and were held between eight and fifteen days apart so that the young people did not have setbacks with their academic activities. 102 students participated in the first semester of the year and rose to 235 students in its second period, who were encouraged to participate in scientific and outreach events held by the National Autonomous University of Mexico (UNAM). which opens every year; Likewise, through a discussion group created on the Facebook page with the same name as the YouTube channel, students could propose their conjectures regarding the concerns they had regarding the topics seen and needs they noticed in their environment.

Figure 3. Discussion and information group on Facebook

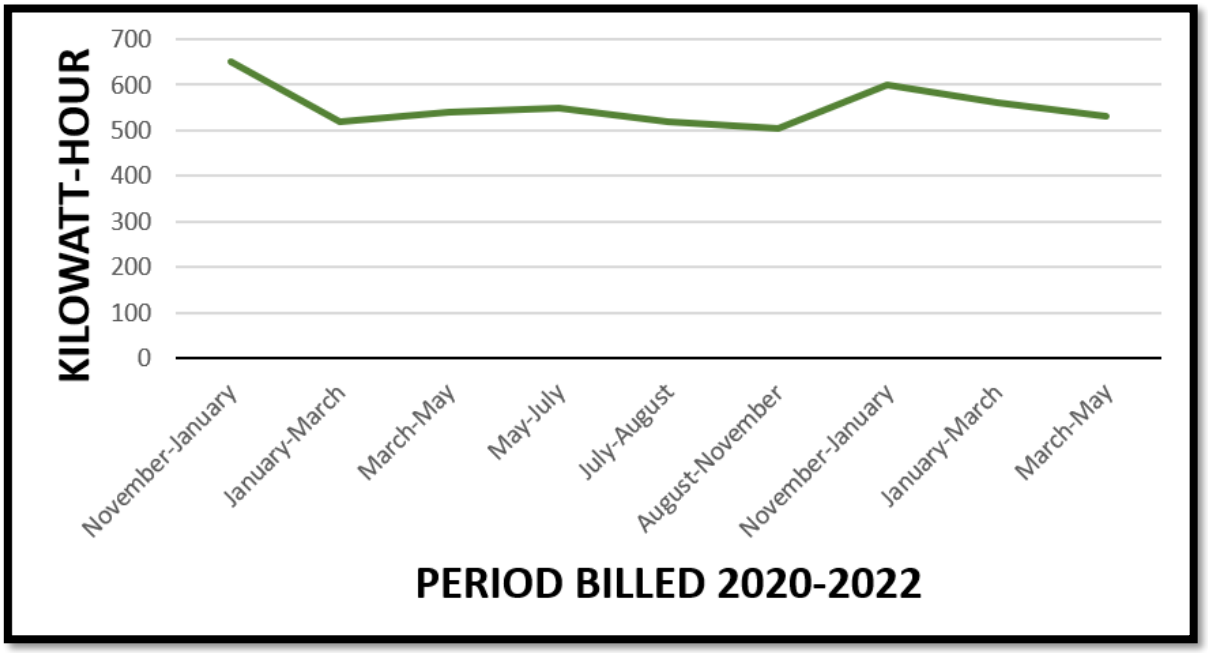
Source: Own elaboration.

In this way, the participants generated a space (Figure 3) where they contribute their visions of the world in concession of the environmental problems that affect them, for this reason, as of June 1, 2021, the materials prepared by the students were made public, where they explain In short videos, global warming and its consequences from their perspective, and through infographics, they propose simple solutions that do not greatly affect people's lifestyles, but that allow the current situation to be improved to thus become a lasting action. for its simplicity.

On the other hand, in general, to have constant feedback on how aware the students are of their actions, a project was implemented per school year where the home energy consumption of the 452 members was collected. It should be noted that those variables that did not have a substantial contribution, such as homes that did not have electrical service, either because they were in an area where CFE does not provide this benefit or because the system has been modified and, therefore, or they do not have a means of registering their consumption or because only the maintenance charge appears on your bimonthly receipt; which is very

difficult to obtain for an inhabited home (since just using a luminaire exceeds that kWh limit). Being 15.9% the number of people with difficulty to be able to obtain their energy consumption.

Figure 4. Household electricity consumption of the study population from November 2020 to May 2022.



Source: Own elaboration.

Thus noting in Figure 4 that the highest consumption corresponds to the period from November 2020 to January 2021, which is consistent with the context of this date due to the use of elements to celebrate the relevant holidays, after which there is a considerable decrease. which is linked to minimizing the cost presented in the previous billing. Regarding the central months, it is noted that there is a very small variation between the expense that was generated, while for July-August and August-November, when work was already being done with the students, a minimum reduction of 2.03% was observed, which is Considerable if one takes into account that the actions to achieve this are aimed at not affecting their day-to-day activities, but small proposals are made to reduce the consumption generated by equipment that is apparently not in operation (reduction in phantom or standby consumption). . As could be expected, the phenomenon is repeated for the period from November 2021 to January 2022, where an increase in energy consumption is shown that is related to the December holidays; One of the advantages is that the peak is lower than last year by a value of 6.54%, which is a considerable percentage in relation to the size of the sample, added to this later in 2022, it is observed that the trend continues to decrease what which reflects that

when they are aware of a greater consumption or economic expense, they take measures to balance their daily actions; This effect has been repeated in both study periods.

At the moment, the actor's perspective has been taken into account so that they can control their consumption, but from future analyzes an open source device will be proposed (elements available in the repository https://cutt.ly/OJRhFO7) that supports understand what your energy impact is instantly and cumulatively; which will have as objective, in addition to making their actions more measured, that they can observe what happens with inactive teams and that they put their theoretical knowledge into practice in the integration of different interdisciplinary fields for the creation of this element that will later serve as a stage of reflective feedback.

All of the above was documented in the design of a workbook for the Physics course from the research perspective, for which the following elements were considered: a user guide, purposes, learning, learning strategies with their corresponding activities, evaluation forms and instruments, teacher assessment of the results obtained and the sources consulted presented in APA format. As well as the elaboration of audiovisual materials (videos, presentations, infographics, Podcast, among others) that include suggestions of concrete learning activities of their use.

It should be noted that a pilot test of the materials was carried out on students enrolled in the subject of Physics II for the period 2022-1, with a duration of 80 hours, which was carried out both synchronously and asynchronously, and that at the end they were provided with a evaluation instrument to measure the quality of the material designed, also at the beginning and at the end of the course another instrument was provided to determine the level of understanding reached by the students. The sample was for convenience and not probabilistic, specifically it was a sampling by purpose. On the above bases, 245 students participated in this study, of which 54.54% were women and 45.45% men from the ENCCH of the Vallejo campus between the ages of 17 and 19, obtaining an approval rate of 86.364%, which It is significant when dealing with an experimental science subject with a high failure rate.

By applying the themes of the Physics study program from the perspective of the proposed model and based on the different quantitative and qualitative evaluation instruments mentioned above in the project, the following results were obtained:

- The students were more active during class, wondering and generating hypotheses about phenomena they saw every day.

- The failure rate for the 2022-2 semester was reduced by 20% compared to 2022-1.
- When applying the final form to observe the acceptance of the young people to the project, 94% indicated that the subject of Physics was interesting and would be useful for their day to day, likewise they could correctly exemplify a practical application in relation to the career they want to study or some aspect that interests them.
- Students are able to explain both colloquially and with Physics concepts what global warming is, they can differentiate it from the greenhouse effect, but at the same time they understand their relationship and impact.
- Public group on Facebook aimed at debate and feedback on the proposed conjectures. It currently houses materials created by students to explain global warming and alternatives to improve it.
- A considerably higher public diffusion than initially expected when considering private environments, which today has more than 6,500 views on YouTube and close to 910 reactions on the proposed works on Facebook.
- The continuity and acceptance of more than 100 students for the implementation of the course-workshop, my impact on the environment and the preparation of materials from their perspective. Thus incorporating experts from different areas of knowledge to provide feedback on the materials created.
- Minimum average decrease of 2.15% in home energy consumption, from the period of 2021, with simple actions that do not change your daily life, by understanding the phantom consumption and non-essential elements in the operation of your different electronic equipment (led lights, options performance, etc.).
- Participation of students in the 10th meeting of the High School Meteorological Stations Program (PEMBU).
- Obtaining first place in the 10th PEMBU meeting with the research work entitled "Analysis of the generation of wind power of the College of Science and Humanities."
- Participation in the XXIX Science Fair University Competition, obtaining first, second and third place in different categories with works entitled: "The temperature and the hot air balloon", "Everything you need to know about vampires", "Proposition of systems to improve environmental coexistence", advised by the different professors belonging to the course-workshop.

- Finalist in the XXX Science Fair University Competition, in different categories, with the works entitled: "The overproduction of garments and the role of friction in their life cycle", and "Myth or reality, does the Sun have an impact in global warming?
- Finalist in the Youth Program towards research in Natural Sciences and Mathematics of the Secretary of Learning Support Services, which made the young people worthy of presenting their project "Environmental Coexistence at the CCH" in the 3rd. Student meeting of initiation to research 2021, and "The influence of the Sun on the Earth's climate" in the 4th. Student meeting of initiation to research 2022.

Discussion

Education is a process influenced by the teachers' beliefs between their epistemological conceptions and pedagogical knowledge (Gallego, Bustamante, Gallego, Salcedo, Gava and Alfaro, 2017), which generates a series of aspects that transcend even the way of life, seeking constitute a comprehensive academic formation of the student and, therefore, has a high responsibility in the development of attitudes, values and knowledge (Rivera, 2016; Laso, Ruiz and Marbán, 2019).

Given this perspective and in order to forge an environmental awareness in the population, a mixed model should be proposed in which it is considered: an interdisciplinary approach that facilitates a systemic and global vision of reality; a critical approach that allows the analysis of behavior in the environment and its pedagogical practices; a practical approach that associates reflection with action; an experiential approach, which allows learning from educational action and, finally, a collaborative and participatory approach that stimulates teamwork to achieve the proposed objectives (Laso, Ruiz and Marbán, 2019).

What highlights the need to train individuals with greater environmental responsibility, since the ecological footprint of each person depends directly on their behavior, requiring promoting changes in individual attitudes (Reina, Labrada and Oduardo, 2020). Reclaiming an environmental literacy that demands: knowledge of the environmental reality and the identification of its problems, understanding of social, historical and ecological processes, the development of environmental sensitivity and the search for available solutions and means of action (SEMARNAT, 2020).

The drawback of this change in thinking is that Mexico is considered among the six most dangerous countries in the world for environmental defenders (Gómez, 2020; Santana, 2020). Therefore, a total change in the perspective of the different systems that aim to find solutions

to the problem of climate change is needed, given that, as mentioned, the human being individually and socially is the key to changing the alarming scenarios. of global warming. Therefore, the strength of the model for environmental awareness based on contextualization is its dynamic, flexible and holistic characteristic, which allows firstly to reflect individually on their actions in relation to their environment and later to relate to more complex subsystems and systems and, with actions with a higher order cognitive level in a transdisciplinary way.

Conclusion

The proposal of the model for environmental awareness based on contextualization in experimental sciences does not seek to replace any model, method or methodology currently used by educational institutions, if it does not serve as an alternative to complement them in relation to the characteristics and qualities of different models. learning assets in order to address a greater number of factors involved in the educational process. Despite the fact that this is complex due to the different elements that are correlated with the system in question, this does not mean that the different actors should not evolve and adapt to the new needs present in society.

It should be noted that the implementation of the proposed model is not limited to experimental sciences, but rather shows how it can be adjusted to a particular subject such as Physics. Reflecting that it was not necessary to lose the essence of the institution, since the particular characteristic of the ENCCH was maintained, complying with the themes, learning and the suggested cognitive levels; only that these elements were correlated daily applications to the context of the students. Serving as a motivator for students to take a more active role in their own educational process, as well as to be able to correlate their theoretical, practical and cultural knowledge, develop their critical thinking and attitudes and tools aimed at the scientific nature.

Contributions to Future Research Lines

In this regard, as lines for future research, it is proposed to guide experts from different areas of knowledge so that they can apply and/or modify this model in order to generate a deeper environmental awareness both in themselves and in their students, to achieve a change in the short, medium and long term in environmental problems in an interdisciplinary way without affecting too much the lifestyle of people, understanding that with simple actions a notable change can be made as a society and that with this it will transition to a lifestyle that is more

respectful of their environment and with this the student acts as a master thinker where they share their experiences and results obtained with their peers.

Just like what happened in all the schools of the National School of Sciences and Humanity, where at the end of 2022, sustainable development clubs were founded in order to meet the sustainable development goals established in the UN General Assembly. by 2030, of which the UNAM is a part and where the present proposal has formally participated from the year 2023 to establish a deeper awareness of the actions of the university and the impact on their environment.

Requiring, therefore, a commitment from teachers so that this correlation can be generated between their subjects with the contextualization that is desired to be addressed, since when foreseeing this type of elements, it is necessary to be very clear about the approach that is wanted. give classes, strategies and tools, since the main point is to generate motivation and interest in the student so that they can visualize in a more practical way what they are studying theoretically and that research questions arise from their present needs; and not that they become saturated with complex environmental issues that it is difficult for them to correlate with their previous knowledge and acquired in this educational process.

References

Alto Comisionado de las Naciones Unidas para los Refugiados [ACNUR]. (2018). ¿Cómo aumentar la conciencia ambiental de la sociedad? Recuperado 03 de octubre de 2020 de https://cutt.ly/nh4x4Nv

Anaya, A. (2019). *Taxonomía de Bloom. Evaluación de los aprendizajes y el impacto en la formación de los estudiantes*. CBTA 159.

Ausubel, D. (1983). Teoría del aprendizaje significativo. *Fascículos de CEIF*, *1*(1-10), 1-10.

Ausubel, D., Novak, J. Y. H. H. y Hanesian, H. (1976). Significado y aprendizaje significativo. *Psicología educativa: un punto de vista cognoscitivo*, *1*(2), 53-106.

Canneti, G. (2020). *La conciencia ambiental es un trabajo de todos*. https://cutt.ly/3h4xpWc

Carmona, M. (2020). *Los niños son los mejores educadores ambientales*. https://cutt.ly/sh4dlXT

Díaz, F. y Hernández, G. (2010). *Estrategias docentes para un aprendizaje significativo una interpretación constructivista*. Mc Graw Hill.

Díaz, J. y Fuentes, F. (2018). Desarrollo de la conciencia ambiental en niño de sexto grado de educación primaria. Significados y percepciones. *CPU-e Revisar de Investigación Educativa*, 26, 136-163.

ENCCH. (2018). Modelo educativo. México: UNAM. Recuperado el 26 de marzo de 2020, de: https://www.cch.unam.mx/modelo

Fuentealba, M. y Soto, L. (2016). Valoración actitudinal frente a temas ambientales. *Revista Luna Azul*, (43), 448-466.

Gallego, D., Bustamante, L., Gallego, L., Salcedo, L., Gava, M. y Alfaro, E. (2017). Estudio cuantitativo sobre las concepciones de ciencia, metodología y enseñanza para profesores en formación. *Revista Lasallista de Investigación*, 4(1), 144-161.

Gómez, T. (2020). *Los desafíos ambientales de México para el 2020*. https://cutt.ly/eh7JMzS

González, E. J. y Arias, M. Á. (2017). La formación de educadores ambientales en México: avances y perspectivas. *Educar em Revista*, (63),53-66.

González, J. y García, E. (2013). *Documentos y Testimonios de la Historia del colegio de Ciencias y Humanidades.* UNAM-CCH.

Laso, S., Ruiz, M. y Marbán, J. M. (2019). Impacto de un programa de intervención metacognitivo sobre la Conciencia Ambiental de docentes de Primaria en formación inicial. *Revista Eureka sobre Enseñanza y Divulgación de las Ciencias*, 16(2), 2501.

Lizárraga, R. (2020). CONCIENCIA AMBIENTAL: Regulando el consumo de energía, ahorramos dinero y cuidamos el ambiente. Recuperado 13 de junio de 2020 de https://cutt.ly/Xh4zUm1

Monayo, E. (2018). Un ensayo sobre la Laudato si' y su contribución a la conciencia ambiental. *Revista de Fenómeno Social*,73(3-4), 441-456.

Monroy, R. (2019). *Enfoque sistémico crítico sobre alcances y limitaciones de las energías renovables: Estudio de caso: La energía solar*. (Tesis posgrado). Instituto Politécnico Nacional.

Muñoz, J. R. (2004). El aprendizaje significativo y la evaluación de los aprendizajes. *Investigación educativa*, *8*(14), 47-52.

Natalichio, R. (2019). *Sólo al 22% de los mexicanos, les interesa el medio ambiente*. https://cutt.ly/Kh7KLNZ

Navea, J. (2018). Acciones ambientalistas para la conservación de las cuencas hidrográficas. *Revista Scientific*, 2(6), 134-153.

Parra, F. J. y Musical, E. (2017). La taxonomía de Bloom en el modelo flipped classroom. *Publicaciones didácticas*, 86(1), 176-179.

Paul, R. y Elder, L. (2003). *La mini-guía para el pensamiento crítico, conceptos y herramientas*. Fundación para el pensamiento crítico.

Reina, M., Labrada, Y. y Oduardo, M. (2020). El desarrollo de la conciencia energética en estudiantes de preuniversitario. Reflexiones necesarias. *EduSol*, 20(72).

Rivera, F. A. (2016). Enfoque sistémico en la formación profesional del auditorio como capital humano. Gestión en el Tercer Milenio, *Revista de Investigación de la Facultad de Ciencias Administración, UNMSM*, 19-1 (37), 31-46.

Rodríguez, G., García, E. y Ibarra S. (2013). *Secuencia ERCA-Modelo de Secuencia de Aprendizaje para el Aprendizaje Adulto*. Alfa.

Román, Y. y Cuesta, O. (2016). Comunicación y conservación ambiental: avances y retos en Hispanoamérica. *Revista Latina de Comunicación Social*, 71, 15-39.

Salazar, J. (2018). Evaluación de aprendizaje significativo y estilos de aprendizaje: Alcance, propuesta y desafíos en el aula. *Tendencias pedagógicas*.

Santacruz, A. (2018). La estrategia del debate en el fortalecimiento de la conciencia ambiental. *Revista Científica Investigación Valdizana*, 12(4), 177-183.

Santana, E. (2020). *2020: Triste año en México para celebrar el Día Mundial del Medio Ambiente*. https://cutt.ly/qh7HA6m

Secretaría de Medio Ambiente y Recursos Naturales [SEMARNAT]. (2020). *Aprueba Comisión Intersecretarial el PECC 2020-2024 y refrenda los compromisos de México ante el Acuerdo de París*. https://cutt.ly/ejenxrr

Sepúlveda, L. (2020). *Universidades de México avanzan hacia la transición energética en Guadalajara.* https://cutt.ly/uh4rKDy

Tonello, G. y Valladares, N. (2015). Conciencia ambiental y conducta sustentable relacionada con el uso de energía para iluminación. *Gestión y Ambiente*, 18(1),45-49.

Twenergy (2020). *Conciencia medioambiental: importancia y como fomentarla*. https://cutt.ly/8h4xnPO

Villarini, Á. R. (2003). Teoría y pedagogía del pensamiento crítico. *Perspectivas psicológicas*, 3(4), 35-42.

Yáñez, D. (2020). *21 de octubre, día mundial del ahorro de energía 2020*. https://cutt.ly/sh4fvGH

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