Virtual active learning - PBL for teaching natural sciences in Basic General Education

1. Margarita Naranjo Valencia, MSc; 2. Jéssica Guevara Sáenz de Viteri, MSc

Universidad de Guayaquil, Ecuador, margarita.naranjov@ug.edu.ec, Orcid 0000-0002-7771-8649

Miembro de OIICE; jessica.guevaras@ug.edu.ec Orcid 0000-0003-1148-0014

Abstract–A sample was made of 50 students of Basic General Education of the República de Francia Educational Unit in thecity of Guayaquil on the characteristics of the PBL (problem-based learning), and its application in the virtual classroom of the Natural Sciences subject, it is evidenced active learning in the management of new technological tools, which provided students with cognitive autonomy during the process. There is an improvement in the teacher-student relationship, as well as clear instructions for each activity

This is how it is considered that the integration of the characteristics of the virtual active learning methodology, are aligned with the PBL, and manage to propose a better conceptual scheme of the information received by the student, contributing to the resolution of problems related to the environment.

Keywords—Problem-based learning, virtual classroom, active learning, basic general education, natural sciences.

I. INTRODUCTION

Education at a global level is undergoing transcendental changes due to the COVID 19 pandemic, which has led to adaptations during the teaching process such as: planning of activities, changes in modality, schedules, and the use of methodological strategies with the use of virtual platforms. [1]

Basic General Education (EGB) in Ecuador ranges from first to tenth grade; counting on the following levels: 1 Initial-Basic, which are included in: 1 High School (sublevel 1) that corresponds to the first grade of E.G.B. 5 years old; 2 Elementary (sublevel 2), which corresponds to the second, third and fourth grade of E.G.B, from 6 to 8 years of age; 3 Medium (sublevel 3) corresponding to: fifth, sixth and seventhgrade of GBS from 9 to 11 years of age, and 4 Superior (sublevel 4), corresponding to eighth, ninth and tenth of GBS from the age of 12 to 14 years.

The Basic Education is classified in the Ecuadorian training system as the most important due to the transfer of knowledge in the minimum essential contents based on the acquisition of skills, abilities and capacities that are part of the high school profile. [2]

Currently, the EGB system has been affected in the knowledge transfer process; since the students present deficiencies related to the use of technology such as: availability of hardware and software equipment, accessibility to digital platforms. As well as connectivity issues. Which generates disinterest in students due to prolonged exposure to electronic devices that are not suitable for running regularcycles in the teaching-learning process.

On the other hand, the teacher is incorporating various resources such as educational guides and pedagogical files; within the curriculum, combining collaborative tools and methodologies to stimulate active participation, promoting inclusion, personalization and intelligence in order to achieve learning achievements based on the achievement of skills by performance criteria.

Additionally, it is worth highlighting the participation of parents in the implementation of learning spaces in their respective homes.

II. CHARACTERISTICS OF THE BASIC EDUCATION LEVEL AND ACTIVITIES POSED BY PANDEMIC COVID

The Level of Basic General Education constitutes the prelude to the Baccalaureate. and the students have specialist teachers in different areas where there is evidence of an increasein actions that require interdisciplinarity, epistemological-disciplinary and pedagogical complexity, deepening the values of: justice, innovation and solidarity; through all the proposed learnings. Being its ultimate goal the stimulus towards the construction of the society of Good Living and diversity.

The Sumak Kawsay worldview is vindicated; that promotes problem solving through logical reasoning and hypothetical-deductive thinking; responsible and committed citizen participation in the care of health, reproductive and comprehensive; through rational communication and the construction of agreements. [3] The understanding of the social processes of liberation, regional integration and construction of alternative social projects directed to the current socioeconomic systems is favored.

Enhanced creations artistic, sports, playful, literary creation etc., and the use of different languages in safe and stimulating environments that value teamwork and question the influence of stereotyped social representations are promoted. [2]

This set of learning works through the technical and ethical use of diverse sources, multimedia, ICT and cartographic resources. The students advance until reaching the exit profile, and develop learning related to areas such as: Language and Literature, Mathematics, Natural Sciences, Social Sciences, Foreign Language, Physical Education and Cultural and Artistic Education. [1] [4]

The results of a sampling carried out in the fourth sub-level of basic higher education will be presented below, where the development of skills and abilities that contribute to the exit profile is evidenced by applying the active methodology, (PBL) Problem-Based Learning from the perspective virtual, which improves teaching in the area of knowledge of Natural Sciences for the 8vo year. [1] [5]

The COVID educational plan for the Ecuadorian educational system contains guidelines for teachers, managers, administrators, Student Council Departments (DECE) and District Units for Inclusion Support (UDAI), in order for the educational community to continue in a manner regular with pedagogical activities. [1]

An educational portal has been implemented; which has more than 95 digital teaching-learning resources. including the use of educational guides, which offer the teacher instruments that facilitate the understanding of the curriculum design model, methodological suggestions that help enrich the teaching. as well as tools for evaluation.

Taking into account as a preponderant factor the training of students, and the overcoming of problems that are shown in the local cultural environment; contributing to the development of the parameters of the meaning of Good Living with oneself, with others and the environment. Reaching important social achievements. [3]

III. PEDAGOGICAL BASES OF THE BASIC EDUACTION CURRICULUM.

The Basic General Education Curriculum deepens the acquisition of skills and knowledge that are developed in the classroom to strengthen citizenship training in the intercultural and multinational field.

The skills and knowledge system presents methodological guidelines and essential evaluation indicators that allow determining the level of quality of learning. Offering the teacher guidance on the development of skills with performancecriteria and attitudes aimed at Good Living, as well as the improvement of quality standards in learning. Among its pedagogical bases we have:

1) Development of the human condition and preparation for understanding.

2) Training of people with the ability to solve problems and propose solutions.
3) Training of people with values such as: solidarity, honesty, sense of inclusion and respect for differences.
4) Training of participatory people in the socio-equitable construction.
5) Emphasis on the use of critical, logical and creative thinking; involving the management of self-reflective intellectual operations.
6) Knowing how to be and do using knowledge as ameans of individual and collective fulfillment.
7) Integration to the domain of action, that is, to the development of skills.
8) Orientation to the use of ICT as instruments for searching and organizing information.
9) Prioritization of reading as a means of understanding and a tool for acquiring culture.
10) Proposal of systematic evaluations, with criteria and integration, taking into account the student's cognitive training, skills and associated knowledge, as well as the formation of human values. [2]

Following, the curricular components of the EGB linked to the PBL are presented

IV. CURRICULAR COMPONENTS OF THE EGB LINKED TO PBL.

In general, the EGB is made up of ten elements that will make it possible to measure the minimum knowledge,attributed to the level of education of the students. Which are detailed

1) Output profile
2) Objectives of the area
3) Integrating curricular axis by areas
4) Learning axis
5) Curriculum blocks
6) Skills with performance criteria
7) Presentation of content
8) Essential evaluation indicators
9) Evaluation with performance criteria
10) Transverse axis. [2]

According to Bruner in his theory, the curriculum must be organized in a spiral way to be able to periodically work on the same contents. With this spiral system, the student is able to change and deepen the mental representations that he has been building with the aim of increasing the development of thought.

The spiral curriculum complies with characteristics such as: logical sequence of contents starting from general to particular or, to put it another way, from the superficial in depth, learning skills to solve problems associated with the environment. [6] [7]

In the case of the PBL methodology, it is harmonized with the components associated with performance criteria skills, presentation of contents that reflect scientific knowledge and a transversal axis in the case of Natural Sciences. [8]

The area of natural sciences responds to the transversal learning axis, becoming a common thread of the curriculum. In this case, the teacher for the development of the subject during its planning must work with one or two skills with performance criteria of the curricular blocks, which will include the use of virtual platforms that start the teaching-learning process.

These are made effective with the application of active and didactic methodological strategies that can be improved through the use of software such as Moodle, using evaluation indicators that determine the performance of students. [9]

are continued with performance criteria in correspondence Skills to the curricular blocks, connecting the topicstreated sequentially using linear logic and attributed to the social and cultural context of the students.

This construction of knowledge must be carried out in a spiral manner in order to seek deepening, connection and articulation with the new issues raised by teachers. [6] [10] [11] Fig. 1

FIGURE 1
SPIRAL OF THE CURRICULUM OF THE E.G.B AND THE PROCESS OF TEACHING-LEARNING PBL
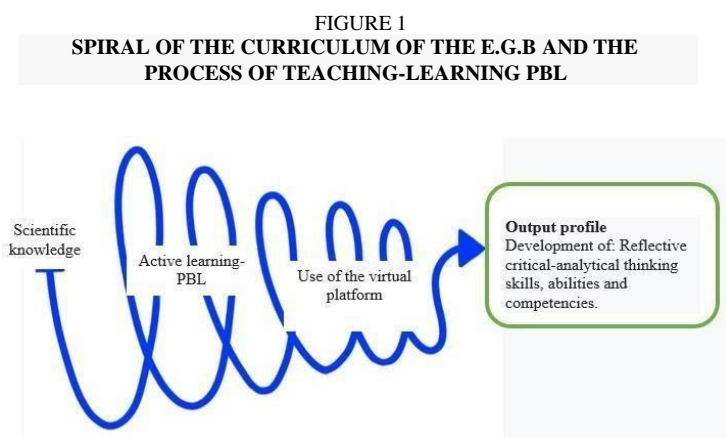
Source: Own authors year 2021

This permanent construction of knowledge and therefore of knowledge that will be evaluated and strengthened by others with the intervention of open-minded students, critical-reflective-systematic thinking; leads to develop the interpretive capacity of the world. from one's own perception through the experience derived from contact with reality.

The fundamental aspects move around an integrated curricular axis of the area in understanding the interrelationships of the natural world and its changes; its axis involves aspects of the design of strategies using information and communication technologies to apply them to the study of science in the school cycle [9]

Being evident in the students at the end of their studies at the EGB that they have integrated knowledge and related it to scientific knowledge; interpreting nature as an inclusive, dynamic and systemic system

V. APPLICATION OF ACTIVE VIRTUAL LEARNING WITH THE USE OF PBL IN THE TEACHING OF NATURAL SCIENCES OF 8TH. LEVEL

Active Learning, according to Fink, consists of an approach that encompasses a set of teaching methods in which students participate in the learning process, through the development of knowledge and the conceptualization of knowledge. [12] teachers use it in response to student learning opportunities

Otherwise, PBL (problem-based learning) is one of the methods that are included in this active learning whose characteristic is based on producing learning under the context of solving current problems. [13] [11] See Fig 2.

FIGURA 2.
CHARACTERISTICS PBL AND OPERATION IN TEACHING - LEARNING PROCESS.

No.	Characteristics of the PBL	It's based on:
1	Problem-centered learning.	Define content and skills to be learned organized around real real problems.
2	Student-centered learning.	Deploy a series of cognitive and affective processes to investigate and solve the problem.
3	Self-direction.	Demand the students to take responsibility for: identifying the learning objectives, planning the collection of information and carrying out the search, processing and integration of information.
4	Self-reflection.	Encourage students to monitor their understanding and learning to adjust their strategies.
5	Active-collaborative work.	Stimulate exchange, dialogue and discussion among peers.
6	Teacher scaffold	Act as a facilitator whose fundamental role is to model and guide processes of reasoning, search and integration of information, facilitate group processes and formulate questions to inquire about the accuracy, relevance and depth of analysis of the information.

Source: Own authors year 2021

It is based on two conceptual and theoretical arguments, one of them is John Dewey, who stressed the importance of learning through real-world experience, and students stimulate their thinking based on a problem by proposing tentative solutions.

The PBL is also based on the sociocultural theory of Vygotsky, who emphasized the importance of student participation in cognitive learning communities, through the exchange and comparison of ideas and the teacher directs their efforts. [14]
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The teacher fulfills the role of facilitator, previously establishing objectives, guidance and rule-based agreements during the activities to be experienced.

Students play the role of leaders during their learning and commit to comply with the agreements and rules; actively participating with his roommates through free software such as Zoom, Meeting, virtual classrooms and others. Finally, they reach the proposed objectives. [15] [16] Fig. 3

It seeks to involve the student in tasks such as: analysis, synthesis and evaluation; developing strategies in which the student reflects on the action they develop. [12]

FIGURE 3
ROLES IN PBL VIRTUAL ACTIVE LEARNING
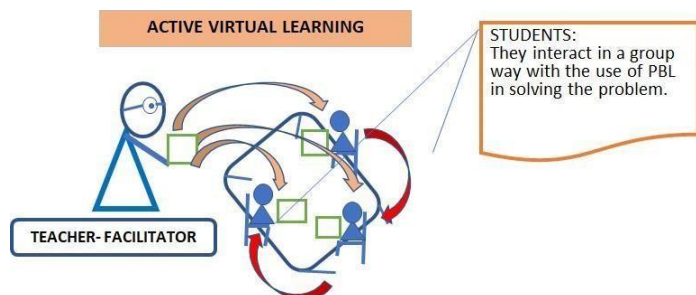
Source: Own authors year 2021

The teaching-learning process relies on computer resources as a virtual platform, which allows interaction between teachers and students; whose main function is to facilitate the creation of virtual environments to impart all kinds of knowledge through the internet.

Regarding the subject of Natural Sciences. It is worth mentioning the topic of Block 4 "Changing climate" in which students understand and value the behavior of physical factors (temperature, humidity, precipitation, among others) typical of their environment.

For the development of the learning process, it involves the approach of various teaching activities, where the theory of PBL is applied combining experiences that achieve:

1. Reflection, based on analysis.
2. Synthesis in the biological, chemical, physical, atmospheric processes for the approximation ofnatural scientific knowledge.
3. Assessment of what has been learned by connecting it to each other and turning it into one's own knowledge
4. Development of procedural skills such as: description, analysis, relationship, comparison, deduction, recognition of the explanation, argumentation that is demonstrated in the virtual classroom platforms through the design of presentations for the classes with the use of various tools, such such as: video calls,group workshops, chats, consultations to virtual libraries, texts, scientific forum type publications, questionnaires, files for receiving tasks, evaluating questionnaires, etc., in an interactive and comprehensive manner. [12] [7]
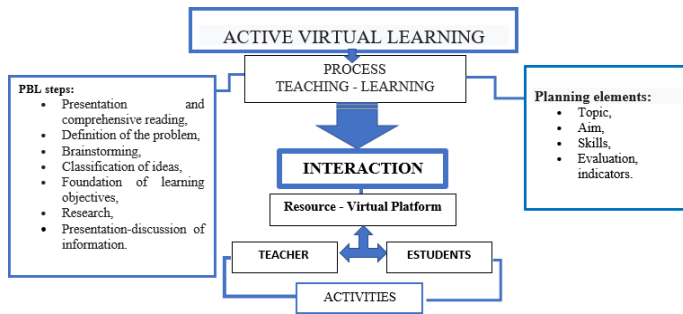
VI. METHODOLOGY

The sampling was carried at the República de Francia Educational Unit located in the city of Guayaquil, Guayas province, eighth grade corresponding to the fourth sub-level of the Basic Superior (EGB), with a sample of 50 students who take the Natural Sciences subject; which is based on the conceptualization of education for training and integral human and social development; self-training that articulates educational processes with changes in habits that promote health and sustainable use of natural resources. [17]

The learning contents called skills with performance criteria are specified from the Didactic Units in the Annual Curricular Planning (PCA) through the active methodology (PBL) [18] that systematizes its order in the following steps. See Fig. 4:

1. Presentation and comprehensive reading of the scenario
2. Definition of the problem
3. Brainstorming and ranking
4. Foundation of the learning objectives
5. Research
6. Presentation-discussion of the information obtained;
7. Evaluation of the learning result according to the resolution of the problem.

This methodology has functionality in the micro-curricular planning of the Natural Sciences subject of the eighth year of the upper sublevel of the (EGB) basic general education due to the group participation in the virtual classroom environment of the students where they will present thoughts, observation, comparison of relationship and analysis with a critical and reflective sense. [19] [20] [21]

FIGURE 4
VIRTUAL ACTIVE LEARNING AND STEPS OF PBL

Source: Own authors year 2021

Involving the steps of the active PBL methodology; in the educational practice of natural sciences in the EGB, corresponding to block four of the micro-curricular planning on the changing climate.

The teacher establishes in the teaching-learning process, with the participation of groups of students for the respective analysis of the problem presented, through the brainstorming technique, and questions (How many types of climate exist?, Where can we find them?, What physical factors influence the climate?, What is temperature?, What is the importance of rain?, How can we prevent global warming?, and What is the use of learning about climate change?.) And how it is attributable to their training. [22] [23] [24]

VII. RESULTS AND DISCUSSION

The research was applied in the Republic of France educational unit in the city of Guayaquil, with a sample of 50 students belonging to the 8th level of daytime EBG

It is worth mentioning that we worked with a medium educational level, who addressed topics from the five curricular blocks of the Natural Sciences subject relating: the earth, a planet with life, the soil and the changing climate.

The survey was directed to students via virtual means and was carried out after the execution of activities of the subject at the beginning of the second semester of 2020, the results of whichreflected the following:

60% of the students considered that the interaction with the teacher improved through the platform, which makes use of virtual tools. This scaffolding of the teacher fulfilled the purposes; followed by 38% who agree

in which they were able to work independently, autonomously and consciously with a critical and reflective attitude through virtual spaces See Table No. 1 and Fig 5

TABLE 1
RESULTS OF ASSESSMENTS ON TEACHER SCAFFOLDING IN VIRTUAL SPACES

Do you think that the interaction of the teacher through the virtual platform was improved during the classes?

VALORATION	FRECUENCY	RESULT
Strongly agree	30	60%
In agreement	19	38%
Indifferent	1	2%
In disagreement	0	1%
Total, disagreement	0	0%

Source: Surveys of students in the Republic of France educational unit 2020

FIGURE 5
RESULTS OF ASSESSMENTS ON TEACHER SCAFFOLDING IN VIRTUAL SPACES
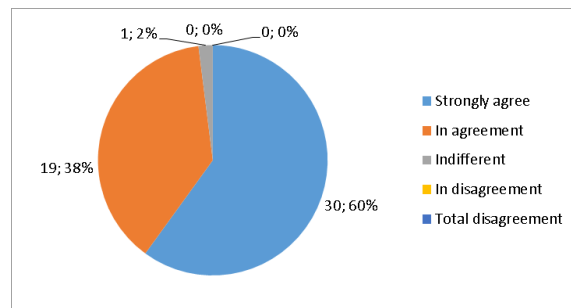
Source: Surveys of students in the Republic of France educational unit 2020

In the question related to problem-centered learning, 78% agree that the teacher socializes results and makes observations about the course work dynamics based on the results. The review and prior analysis of the subject to be discussed was carried out; 20% agreed that the teacher's performance was reflected as a transmitter of indications and guidelines for the development of the activity in the virtual environment See table2 and Figure 6

Do you think that the teacher socializes, directs and reviews virtual activities?

VALORATION	FRECUENCY	RESULT
Strongly agree	39	78%
In agreement	10	20%
Indifferent	1	2%
In disagreement	0	0%
Total, disagreement	0	0%

Source: Surveys of students in the Republic of France educational unit 2020
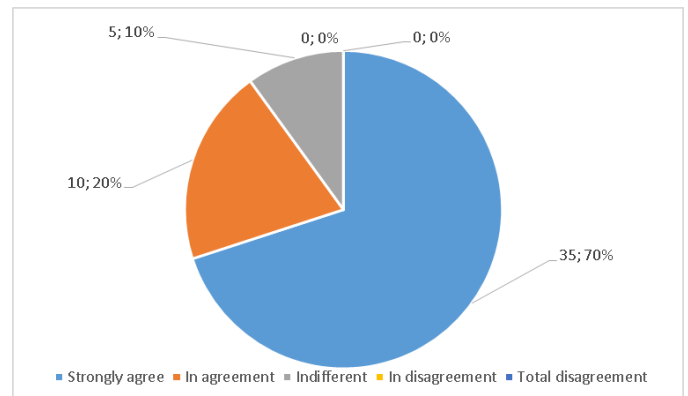
TABLE 3
RESULTS OF ASSESSMENTS ON SELF-REFLECTION

Do you consider that the questioning technique contributes to class participation and increases your knowledge?

VALORATION	FRECUENCY	RESULT
Strongly agree	35	89%
In agreement	10	8%
Indifferent	5	3%
In disagreement	0	0%
Total, disagreement	0	0%

Source: Surveys of students in the Republic of France educational unit 2020

FIGURA 6
RESULTS OF ASSESSMENTS ON PROBLEM-CENTERED LEARNING

Source: Surveys of students in the Republic of France educational unit 2020

FIGURA 7
RESULTS OF ASSESSMENTS ON SELF-REFLECTION
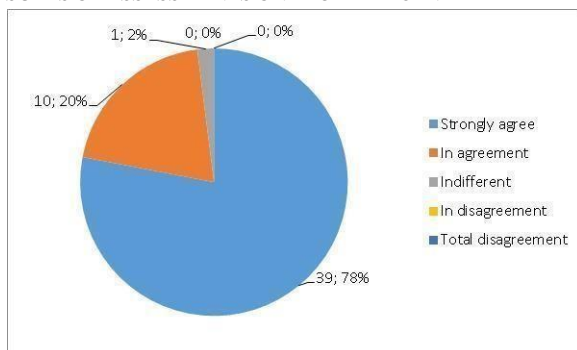
Source: Surveys of students in the Republic of France educational unit 2020

Regarding the question on self-reflection, 89% strongly agreed that the teacher used the technique of investigative questions while using the virtual platform with the integration of student participants. 8% of the students agreed that they value the knowledge acquired and that they contribute the knowledge to their daily life See table 3 and Figure 7.

Student-centered learning was analyzed in a question whose result reflected that 85% strongly agree that the teacher achieved collaborative interaction by creating groups of students during virtual class and supervised by the teacher; 15% agreed that they also developed skills in the management of the Moodle platform, as well as in the management of virtual tools and that the activities of elaboration of homemade models helped to represent realities of the environment such asthe use of the Plant block hydraulics related to water .. See table 4 and Figure 8 and Figure 9

TABLE 4
RESULTS OF ASSESSMENTS ON STUDENT-CENTERED LEARNING

Do you think that the work group formation phase for processing increased individual interaction with mutual help between students?

VALORATION	FRECUENCY	RESULT
Strongly agree	37	85%
In agreement	12	15%
Indifferent	1	0%
In disagreement	0	0%
Total, disagreement	0	0%

Source: Surveys of students in the Republic of France educational unit 2020

FIGURE 8
RESULTS OF ASSESSMENTS ON STUDENT-CENTERED LEARNING
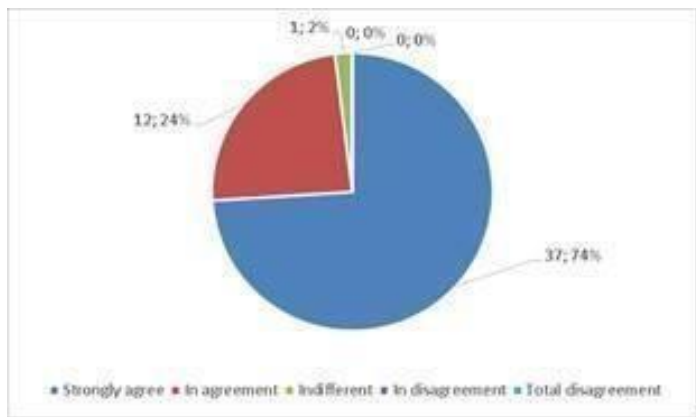
Source: Surveys of students in the Republic of France educational unit 2020

FIGURE 9
STUDENT AND PARENT MAKING MODEL HYDRAULIC PRESS

VIII. CONCLUSIONS

The characteristics of the PBL were analyzed in the survey questions and its results reflected that:

The teacher scaffolding according to 60% of the students considered that the interaction between teacher and student existed and improved through the platform, and that they made use of virtual tools such as forums, tasks, virtual animations, boxes for feedback and tasks individual. Greater participation was also evidenced through the Moodle platform and the use of Zoom, which served as support for students who learned how to use these tools that they were unaware of before the pandemic.

Regarding self-reflection, 89% strongly agreed that the teacher used the investigative question technique during the use of the virtual platform, as well as forums with questions that related situations of daily life and that allowed the integration of student participants responding. 8% of the students agreed that they value the knowledge acquired and that they contribute the knowledge to their daily life.

In the question related to Learning focused on the problem, 78% strongly agree that the teacher socialized the results of the individual evaluations and that they made observations on the presentations of the course work, such as the models were made on the press hydraulics and other flip charts about places in the world with types of climates.

The review and prior analysis of the topic to be discussed was carried out, by the teacher 20% agreed that the action reflected that the teacher gave clear instructions and guidelines for the development of the activities proposed in the Natural Sciences class, as well as in the virtual classroom presented in Moodle.

Regarding student-centered learning, a question was analyzed, the result of which reflected that 85% of students strongly agreed that the teacher achieved collaborative interaction by creating virtual rooms for groups of students during virtual class and they were supervised in a timely manner.

The learning was also oriented to the development of skills in the management of the Moodle platform, as well as in the management of virtual tools such as forums, active questionnaires, and elaboration of tables.

The activities of making models made at home with the help of their relatives helped to represent realities of the environment such as the use of the Hydraulic Plant in the study of the block of the subject related to water.

Finally, it was concluded that the PBL characteristics were optimally adjusted to the learning of the students of this higher level of the EGB, since as the virtual classes progressed, they progressively overcome each obstacle that the new modality represented and they learned the use of new ones. technological tools which gave them autonomy during thelearning process and the development of social skills

This is how it is considered that the integration of the characteristics of the virtual active learning methodology, are aligned with the PBL, and manages to propose a better conceptual scheme of the information received by the student, contributing to the resolution of problems related to the environment

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