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Modelo de formación integral basado en el desarrollo de experiencias significativas y experimentales en el aula mediadas por la tecnología y la innovación

The comprehensive training model based on the development of significant and experimental experiences in the classroom mediated by technology and innovation

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Resumen En este documento se presentan las principales características del modelo de formación integral basado en el desarrollo de experiencias significativas y experimentales en aula, mediadas por la tecnología y la innovación, propuesto por el grupo de trabajo en STEAM de la Corporación Universitaria Comfacauca Unicomfacacua. El modelo se fundamenta ***en el desarrollo de actividades de aprendizaje significativas y transformadoras*** que promuevan el acercamiento de estudiantes y docentes a ambientes de aprendizaje en contextos reales, prácticos, experimentales y vivenciales; analizados y comprendidos desde la integralidad del saber, la mediación tecnológica y la innovación. A partir de su aplicación se busca propiciar en el estudiante el desarrollo de capacidades cognitivas y conductuales, que le permitan afrontar de manera efectiva los retos y desafíos del mundo cambiante de hoy inmerso en la sociedad del conocimiento. Entre las competencias que persigue el modelo se destacan: confianza, carácter, gusto y pasión por aprender, ética y valores, flexibilidad, adaptabilidad, autoevaluación, comunicación, búsqueda y manejo de información, trabajo colaborativo, trabajo autónomo, resolución de problemas y toma de decisiones.

Palabras claves STEAM; ABP; Aprendizaje significativo; metodologías activas; pedagogía.

Abstract A comprehensive training model developed by the STEAM working group of the Corporación Universitaria Comfacauca Unicomfacacua is released. The model is based on the development of meaningful and experimental experiences in the classroom mediated by technology and innovation. This model is based on the development of meaningful and transformative educational activities that promote the approach of students and teachers to learning environments in real and experimental contexts and mediated by technology. By applying the proposed model, the aim is to encourage the student to develop cognitive and behavioral skills, which allow him to face the challenges of the changing world. Among the competencies that the model pursues, the following stand out: Confidence, character, taste and passion, ethics and values, flexibility, adaptability, self-evaluation, communication, search and management of information, collaborative and autonomous work, the development of activities and processes, problem solving and decision making.

Keywords STEAM; ABP; Significant learning; active methodologies; pedagogy

1 Introduction

The Comprehensive Training Model Based on the Development of Significant and Experimental Experiences in the Classroom Mediated by Technology and Innovation is about a pedagogical innovation whose didactic approach wants to promote an active and significant learning; In accordance with this, according to Ausubel (2002), the person builds their learning from their interests, needs and previous knowledge, in interaction with new knowledge; In turn, according to Vygotsky's theory of social interaction according to ALC Salas (2001), knowledge is considered as a social construction developed in processes of interaction and acts situated in a specific cultural context.

The proposed model manages to articulate the missionary functions of teaching, research and extension of higher education institutions in the country. Regarding teaching, the subjects and their contents are taken as base elements, where the cognitive characteristics of the students are identified, the development of capacities supported using technologies, innovation and creativity is planned, as well as learning outcomes are established in accordance with performance levels. From the point of view of research, the strategy enables the development of a research culture and experimentation, promoting the active participation of students and teachers in educational research activities and academic networks.

In relation to extension, the model enhances contextual learning, allowing integration between theory and practice, helping and strengthening the institutional relationship with the productive sector, positioning teachers, students and graduates in terms of competitiveness and quality, Likewise, the strategy promotes the development of active and significant learning experiences that seek to minimize the risk of student dropout and ensure their permanence in the educational system.

In this article we want to present the advances in the design of The Comprehensive Training Model Based on the Development of Significant and Experimental Experiences in the Classroom Mediated by Technology and Innovation, developed by the STEAM working group of the Corporación Universitaria Comfacauca, Cauca, Colombia.

2 Background

Since 1999 with the Bologna process, European universities began to make the transition from an educational model focused on teaching to a model focused on learning, its main objective was to put an end to master classes, the predominant method in most universities and search for methodologies that favor teaching in competencies in a more effective way. Currently the development of humanity is framed in three fundamental archetypes, globalization, the knowledge society and advances in information and communication technology - ICT

In this way, and as with the Bologna process, since 2004 the universities of Latin America have been orienting their reflections on the development of methodologies that help students to occupy a place in the knowledge society, which facilitates their insertion into an increasingly globalized and interconnected world, In this way, the training of human talent becomes an element of vital importance for developing countries to achieve the strategic adjustment between competitiveness, economic growth and quality of life.

All these efforts to think jointly about the academic (recognition by the academic community) and professional horizon (recognition by colleges and professional groups) is one of the central lines of the Tuning project cited in the book *Reflexiones y Perspectivas de la Educación Superior en América Latina Informe Final* – Tuning Project – Latin America 2004-2007.

Following the same philosophical line of the Bologna treaty, it is important to consider the influence on the new educational models of the audiovisual media and the mass media applied to the educational field, and as was pointed out in the work of Cabero, 2001, In these years curricula do not have to be back to the total integration of teaching-learning in terms of

specific objectives such as the daily use of ICT tools and environmental resources as methodologies that lead to effective education.

Regarding the study of active methodologies, according to the author Hipólito González these should contain two objectives. First, help students deepen the content of the materials they are studying. Second, the permanent and long-term utility, to develop in students the intellectual honesty and the necessary discipline, so that they permanently question their thinking.

In relation to the use of active methodologies in the teaching-learning processes, it should be noted that; La Corporación Universitaria Comfacauca at its headquarters in Santander de Quilichao, in the North of the Department of Cauca, since 2012, has been incorporating in its pedagogical and teaching practices, the design of methodological and didactic strategies that respond effectively to the learning dynamics and particularities of its academic community and that promote with quality and relevance the training demands of the region's productive sector, in a population characterized by its great ethnic and cultural diversity, with a high level of internal conflict and social contrasts essentially related to the aftermath of the armed conflict which have a negative impact on the economic development and quality of life of its inhabitants.

In accordance with this situation, an interest in study, analysis and reflection is promoted within the faculty of engineering, in the face of teaching-learning processes and from the integration of an academic group represented by teachers, students, managers and graduates, a process of search and selection of referents related to engineering teaching at a national and international level is undertaken, in order to identify and incorporate pedagogical and technological innovations that are adapted to the particularities of the student population.

In this way, the work team, and the results of the documentary search, suggest the adoption of the "Methodological Strategy for Teaching Project-Based Learning - PBL" as a response of educational innovation that adjusts to the requirements and particularities mentioned above, being consistent with the postulates of the PEI and the pedagogical model, since it favors the consolidation of the principles of freedom of thought and expression, academic freedom, research, learning and entrepreneurship, in addition to promoting an integral formation supported by the development of institutional values such as: teamwork, excellence, pluralism, respect and responsibility.

In the same way, the admission of the active methodology of experiential and significant learning PBL, tends towards a solid scientific and technological training, at the same time that it promotes ethical and reflective training, based on the opportunity to directly access the dynamics and problems of the productive sectors of the region.

Thus, students become the center of the training process, becoming aware of their evolution in learning, as they are constantly motivated and challenged by their teachers to propose innovative and creative solutions to specific problems, which can be resolved from of the application of the scientific, technological, and humanistic knowledge acquired during their training.

Finally, it is important to recognize that the implementation of the active learning strategy PBL has contributed to the institutional positioning and recognition of graduates in the workplace; a reflection of this, is the job placement rate, which amounts to 80% of the faculty's graduates, denoting the relevance and pertinence of the training model.

The development and implementation of active learning methodologies in higher education institutions have proven to be an effective alternative to progressively migrate from the traditional educational approach based on the transmission of knowledge to the autonomous and significant learning, where the dynamics in the classroom and learning environments must be transformed into experiences of collaborative work and personal growth, that respond to the prevailing needs of the new human being in formation, dynamic, highly flexible and creative, and in turn respond to the changing requirements of the environment in the information and knowledge society.

Around 2018, the STEAM working group was created in the faculty. A group of science and engineering teachers, who were motivated to improve their pedagogical practices and develop new and

significant learning experiences, seeking to explore and propose both theoretically and experimentally novel learning techniques that facilitate the appropriation of knowledge and enhance the development of skills in students.

This is how, based on reflexive and systematic analysis, regarding the requirements imposed by the current knowledge society and in response to the new dynamics, motivations, tastes and preferences of the human being in formation, After two years of work by the STEAM group, the proposal called "The Comprehensive Training Model Based on the Development of Significant and Experimental Experiences in the Classroom Mediated by Technology and Innovation" whose epistemological foundations are: active learning, educational innovation, creativity, formative research, experimentation, technological mediation, learning by doing, human development, the formation of the human being, learning to learn, unlearning to learn, comprehensive, relevant, quality, experiential, meaningful and lifelong training.

3 Methodology

The main objective of the comprehensive training model is based on the development of meaningful and transformative educational activities that promote the approach of students and teachers to learning environments in real, practical, experimental and experiential contexts; analyzed and understood from the integrality of knowledge and technological mediation.

From the experiences, the model pursues the development of its guiding principles such as: argumentation, experimentation, research, innovation, creativity, comprehensive training and intermediation and technological appropriation.

The purpose of the application of the model is to encourage students to develop cognitive and behavioral skills, which allow them to effectively face the challenges of the changing world. Among the competencies pursued by the model, the following stand out: trust, character, taste and passion, ethics and values, flexibility, adaptability, self-assessment, communication, search and management of information, collaborative work, autonomous work, development of activities and processes, problem solving and decision making.

After the development of significant and transformative learning activities, students are expected to have the ability to relate, where and how the learned concepts can be used, that is, to have the ability to identify the different contexts of application of the knowledge acquired.

Similarly, for the development of significant and transformative learning activities, it is important to previously define the following characteristics; competences, skills and learning results that are to be privileged according to the curricular topic under study; the learning environment represented by technological means and ICT tools, the physical didactic space where the activity will be developed for its contextual and spatial adaptation, the duration of the activity and not least the teachers or work team responsible for the activity .

The sequence of steps for the development of significant and transformative learning activities proposed by the Comprehensive Training Model Based on the Development of Significant and Experimental Experiences in the Classroom Mediated by Technology and Innovation is described below.

3.1 Activity one

Recognition of students' pre-knowledge.

Conceptual note for the teacher: it is suggested to the general teacher a conceptual clarity according to the pre-knowledge diagnosis carried out previously. Scope of the activity: build a conceptual idea about the topic under study, its use and relationship with everyday situations.

Procedure: this activity is carried out from the formulation of motivating or challenging questions directed towards students, in order to identify aspects such as:

Where and how can the concepts under study be used?

How is the concept under study related to everyday situations?

3.2 Activity two

Connect the concepts in an experiential way.

Scope of the activity: have a practical and experiential approach to the subject to be discussed.

Procedure: appropriation of the concept and its use, based on theoretical and practical exemplification.

3.3 Activity three

Recognition of application contexts.

Scope of the activity: promote a systemic and integral learning context based on the skills and abilities that are privileged according to the curricular topic under study.

Procedure: A current text, article or publication is selected for the development of this activity, which is related to the curricular topic under study.

This knowledge-integrating activity seeks to strengthen the training elements in accordance with the generic competencies proposed by the Saber-pro higher education quality assessment model, its adaptation is described below:

Critical reading component: its objective is to develop capacities to understand, interpret and assume critical and reflective positions regarding a topic, based on the reading of a document that involves a context of application of daily life.

Written communication component: its objective is to develop skills to communicate ideas in writing related to a particular topic or knowledge, in an application context.

Quantitative analysis component: its objective is to develop abilities to understand, execute and establish strategies to analyze and solve problems with information or representation of quantitative data related to a given context.

Foreign language component - English: its objective is to develop abilities to understand and interpret information in a foreign language related to the topic of study in a context of everyday life.

Citizen competencies component: its objective is to develop capacities to assume critical and reflective postures against the impact of their actions within a context or community.

Technological component and innovation: its objective is to develop skills for the efficient use and management of information mediated using ICT tools and their impact in a given context. As Julio Cabero said in *replanteando la tecnología educativa* (C. A. Julio 2003): "Any type of medium, from the most complex to the most elementary, is simply a didactic resource, which must be mobilized when the objectives are reached..." and in this sense the model suggests the use by teachers of technological communication resources (ICT) to facilitate students' learning.

4 Results

It is important to clarify that this article only seeks to make known the theoretical and conceptual foundations of the comprehensive training model developed by the STEAM working group of the Corporación Universitaria Comfacauca Unicomfacacua.

This section will be oriented towards the identification of general results that have been systematized from the implementation of the model by some teachers of the faculty in their academic subjects, as well as collecting some perceptions of the students who have participated in the significant experiences developed using the proposed model.

The application of the model has become an innovation challenge for students and teachers, since its operation involves a whole planning process that ensures that the learning activities proposed by the teacher achieve the relevance to be classified as significant and transformative experiences. Likewise, restrictions imposed by institutional dynamics related to aspects such as dates and forms of evaluation, teaching-learning paradigms, compliance with the contents in the established times, lack of flexibility and adaptation of the curriculum to new training demands.

It is also noted that, in terms of adapting to the dynamics proposed, a great deal of flexibility and

receptivity has been achieved by teachers who teach subjects in the basic sciences component, where it is easy to establish a relationship between theory and practice as well as how to define experiential learning activities in a given application context, whether real or simulated.

It is important to highlight that the model seeks that teachers are always involved in significant and transformative learning activities, the use of available technological tools by students; as we can see in figure 2, students are allowed to use tablets, smart phones and computers.

Below are some results of the preliminary perception survey, applied to students from different study programs of the corporation, who participated in subjects where they had the opportunity to develop learning activities using the proposed model.

(a) Classification of the student population by study program (see Figure 1).

Figure 1. Classification of the student population by study program.

(b) List of subjects in which meaningful activities were carried out: Physics I, Physics II, Mathematical Logic and Thermodynamics.

(c) Characterization of the students' perception survey regarding the learning experiences mediated by the model; the instrument used was based on the Likert scale, which proposes the following rating scale of a nominal or categorical nature: Strongly agree, Agree, Neutral, Disagree, Strongly disagree (Gracia, T. I. 2011).

(d) Perception survey design; The evaluation instrument used consists of fifteen questions, which are listed below:

- Regarding the activity carried out. Do you consider yourself satisfied?
- Do you consider that the concepts carried out in the activity are useful in your daily life?
- Do you consider that the activity carried out is in line with the programmatic content?
- Do you consider that the activity carried out motivates group work?
- Do you consider that the activity carried out associates the new information with the information you already have?
- Do you consider that the activity carried out provides fundamentals that you could take advantage of from a personal level to a work level?
- Do you consider that the activity carried out motivates open and understanding dialogue with others?
- Do you consider that the activity carried out motivates allows a relationship between theoretical concepts and computer tools?
- Do you consider that the activity carried out allows the assessment of your effort to achieve the academic objectives?
- Do you consider that the activity allows you to develop search activities and information management?
- Do you consider that the activity carried out has follow-up and accompaniment by the teacher?
- Do you consider that the activity carried out is boring?
- Do you consider that the activity carried out allows you to apply your creativity?
- Do you consider that the activity carried out inspires confidence?
- Do you consider that the activity carried out is a novel idea?

(e) Partial results of the application of the perception survey to 40 students of one of the courses.

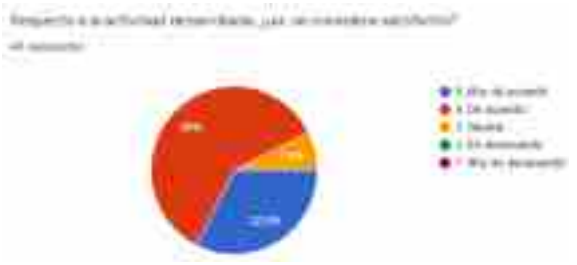

Figure 2. Student perception regarding the activity carried out.

As can be seen regarding the level of satisfaction of the activity (see figure 2), 60% of the students declare to be agree, 32.5% are very satisfied, and 75% are indifferent or neutral.

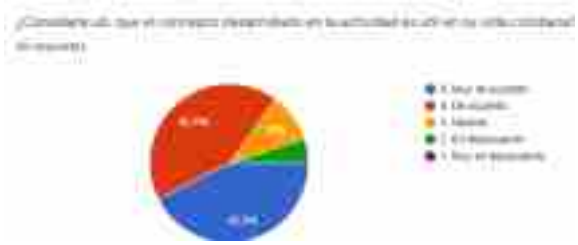

Figure 3. Student perception regarding the relevance of the topic with everyday life.

According to the relevance of the topic and its relationship with everyday life, 42.5% of the students consider that they are strongly agree.

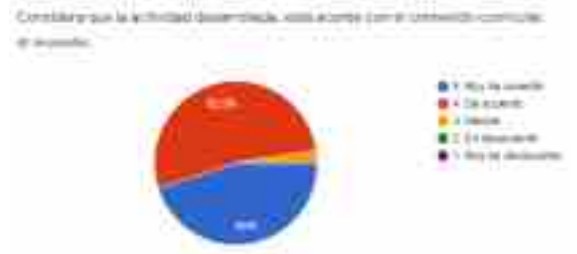

Figure 4. Student perception regarding the relationship of the subject with the curricular content.

According to the relationship of the activity with the contents proposed by the course (see Figure 4) 45% of the students declare to agree with what is defined, while 52.5% are strongly agree.

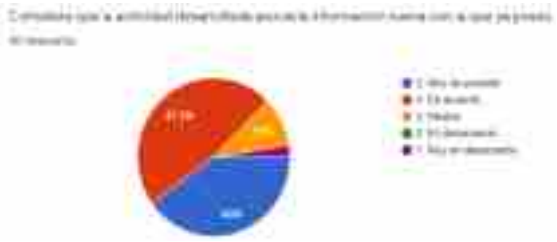

Figure 5. Student perception regarding the relationship of the topic with the information prior to the activity.

Regarding the recognition of previous knowledge and its relevance in the development of the activity (see Figure 6) 47.5% of the students declare to agree, while 40% are strongly agree.

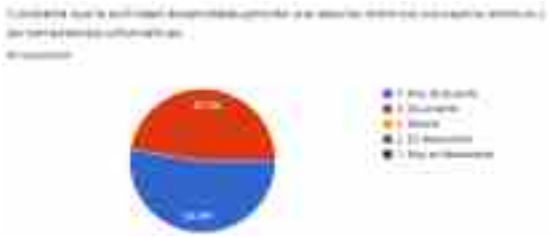

Figure 6. Student perception regarding the relationship of the topic with theoretical concepts and computer tools.

According to the importance of the use and appropriation of information technologies in the development of the activity, 47.5% of the students declare to agree while 52.5% are strongly agree.

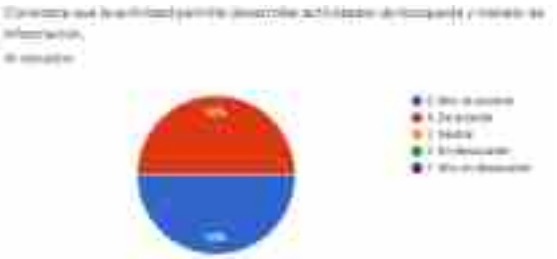

Figure 7. Student perception regarding the relationship of the topic and the activities of searching for new information.

Regarding the importance of the management and search of information in the development of the activity, (see figure 7) 50% of the students declare to agree while 50% are strongly agree.

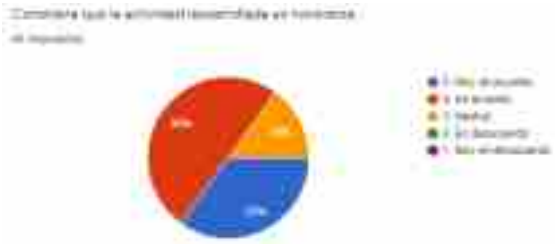

Figure 8. Student perception regarding the novelty of the carried-out topic.

Finally, 85% of students consider the activity as novel (see figure 8), in this sense 35% of students consider it very novel, for the remaining 15% of the students, was indifferent or equal to others. From the interpretation of the results of the students' perception survey regarding the activities proposed by the model, it is possible to infer that the vast majority have a positive comment regarding the learning experience, classifying it as novel and meaningful.

In figures 9 and 10, images of some moments of the section in the development of the learning experience are presented.

It is important to mention that the activities take place in spaces other than the usual classroom, in this sense it is important to observe the distribution and organization of the learning environments, which encourage the active participation of students, generating moments of coexistence and collaborative work.

Figure 9. Physical space where the significant learning experience took place.

Figure 10. Material used to develop of the context activity.

Future Work. Activities of meaningful experiences are being developed within the STEAM working group in Unicomfacacua applying the "The Comprehensive Training Model Based on the Development of Meaningful and Experimental Experiences in the Classroom Mediated by Technology and Innovation" to carry out in different subjects and conduct a formal investigation of the response in academic performance before and after the application of the model.

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