EDUCATIONAL INTERVENTION IN THE SUBJECT HYDRAULIC ENGINEERING I OF THE UNIVERSIDAD TÉCNICA DE MANABÍ, ECUADOR

Xavier Horacio Valencia-Zambrano, María Rodríguez-Gámez

ABSTRACT

Objective: Propose a methodological structure that helps the teacher apply new strategies that enhance educational work.

Methods: The inductive-deductive method and the bibliographic review method were applied.

Results: The subject is developed in a traditional way where the teacher occupies the center of the process through the dissertation of master classes, whose contents are the theoretical foundations of the topics, followed by the resolution of practical exercises with the use of the blackboard or through a projector, a scenario in which the student is only a passive actor in the process.

Conclusions: A methodology was developed that can cause difficulties in the incorporation of teachers into the learning community; but with this, substantive changes are achieved in the teaching and learning of the subject hydraulic engineering I.

Keywords: Educational intervention, learning strategies, traditional method, ecological approach.

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INTERVENÇÃO EDUCACIONAL NO ASSUNTO ENGENHARIA HIDRÁULICA I DA UNIVERSIDADE TÉCNICA DE MANABÍ, EQUADOR

RESUMO

Objetivo: Propor uma estrutura metodológica que ajude o professor a aplicar novas estratégias que potencializem o trabalho educativo.

Método: Foram aplicados o método indutivo-dedutivo, revisão bibliográfica.

Resultado: A disciplina é desenvolvida de forma tradicional onde o professor ocupa o centro do processo através da dissertação de master classes, cujos conteúdos são os fundamentos teóricos
dos temas, seguida da resolução de exercícios práticos com recurso ao quadro negro ou através de um projetor, um cenário em que o aluno é apenas um ator passivo no processo.

**Conclusão:** Foi desenvolvida uma metodologia que pode causar dificuldades na incorporação dos professores na comunidade de aprendizagem; mas com isso conseguem e mudanças substantivas no ensino e aprendizagem da disciplina engenharia hidráulica I.

**Palavras-chave:** intervenção educativa, estratégias de aprendizagem, método tradicional, abordagem ecológica.

1 **INTRODUCTION**

One of the difficulties found in the subject of hydraulic engineering I at the Universidad Técnica de Manabí (UTM), is the lack of a methodological structure that is committed to incorporating teaching-learning methods that are derived from traditional methods, so that students can understand that the discipline must start from the cognitive analyzes of the social process. Achieving through research to characterize what happens in the current teaching process, this will allow us to propose an intervention plan that guides the teacher to apply new strategies that today enhance educational work, even though there may be difficulties for teachers to internalize the processes. proposed, as they are incorporated, substantive changes will be obtained in teaching and learning that can improve as the need to transition to new ways of teaching is understood.

2 **THEORETICAL FRAMEWORK**

Population increase, pressure on natural resources, inadequate land use and natural phenomena such as earthquakes, floods and droughts challenge the civil engineering programs of the universities of the province of Manabí to take a strategy with a new vision, be more creative in the use and application of new technological tools that favor the training of competent professionals committed to concrete solutions to the aforementioned problems.

The current legal framework contemplated in the Organic Law of Higher Education LOES and its related regulations, enshrine within its principles, a relevant higher education that responds to the demands of society in Ecuador (LOES, 2010). In this way, the study of the regional context in the broadest sense of its meaning is fundamental in the teaching and learning process of engineering careers.
The UTM It is a public law institution founded in 1952 and its creation responded to the need to train professionals to prepare for the demands of a predominantly agricultural region. In the last 10 years the number of students has grown approximately from 12 thousand to 35 thousand.

The Faculty of Mathematical, Physical and Chemical Sciences (FCMFQ) is one of the largest in the university, and currently has 4,778 students, offering 9 majors, among which is Civil Engineering with approximately 1,379 students.

Contrary to the constant principles in the LOES, the curricular mesh of the engineering career is expressed as the sum of a set of subjects structured in such a way that its syllables (among which is the one corresponding to Hydraulic Engineering I) are components with contents isolated where the study of the context is scarce in the teaching and learning process.

Based on the diagnosis of what occurs in the teaching and learning process in the subject of Hydraulic Engineering I, it is proposed in this research to apply an intervention plan, whose fundamental purpose is to promote the formation of a learning community to improve quality and the relevance of its curricular activities through the incorporation of the regional context as a relevant element in the teaching and learning process.

3 METHODOLOGY

To fulfill the objective proposed in the first place, with the help of the previous review of the theoretical framework, a diagnosis of the teaching-learning process was carried out, which included a characterization of the contents of the subject, the forms of teaching and learning, its evaluation procedures, definition of teacher and student profiles. After this characterization, an action plan was proposed based on a strategy with an ecological approach in education where the student is the protagonist of the teaching and learning process. An experiment was carried out where the teacher acts as a facilitator to apply educational and technological resources such as classes, face-to-face and flipped classroom, collaborative workshops, laboratory observation practices, case studies and formative evaluation. With the inductive-deductive method, the theoretical framework and the current educational legal framework were reviewed, as the work material used, the curricular mesh of the civil engineering career was highlighted, the syllable updated under the consideration of keeping in mind the socio-economic context in the that the topic to be discussed was developed, with these it was possible to carry out the specific
action plan based on the time distribution that officially appears in the syllabus of the subject.

4 RESULTS AND DISCUSSIONS

Manabí is one of the 24 provinces of Ecuador located in the coastal zone and occupies a third of the country's coastal profile with nearly 350 km of beach. With its 19,472 km² of territorial extension has a projected population by 2021 of 1,562,079 inhabitants, which places it in third position in the country (INEC, 2017).

One of the main characteristics of the province is its geographical irregularity, a situation that prevents the supply of water from the Andes Mountain range (Portilla, 2018). This provincial geographic particularity contributes to the configuration of four features that distinguish it: difficulty in developing efficient agriculture (Daza, Artacker, & Lizano, 2020), the most important of socioeconomic activities; susceptibility to the occurrence of extreme climatic events (floods and droughts); uniqueness in the identity traits of its inhabitants, different from those of other coastal provinces; late presence of the State in all its actions, especially in education. This last feature explains why UTM was founded 334 years after the establishment of the country's first university (Ganga & Maluk, 2017).

Su objetivo inicial respondió a la necesidad de formar profesionales en ingeniería, agricultura, mecánica y veterinaria, en una población rural mayoritaria; además de la necesidad de desarrollar la economía de la provincia, la idea de tener una universidad regional significaba abrir nuevas posibilidades a la cultura de la región.

The UTM began its work with 2 majors, 18 students and 6 professors (Universities, 2023), and currently its academic offer is 11 faculties, 51 majors, 72 postgraduate programs and nearly 900 professors. This unusual growth in recent years is due to the increase in the number of high school graduates and the public policies and significant investment generated by the State in the last decade. Without a doubt, it joins the group of universities that (Brunner, 2012a) qualifies as organizations that fulfill technical and professional training functions.

The Vision of the career clearly shows the focus on training leaders at the national level and solidly linked to the technical, social, political and economic environment,
while the mission places emphasis on the training of engineers with solid scientific, technological and technological knowledge, humanistic values (Manabí, 2016).

In accordance with the redesign resolution RHCU.UTM-No 224-SE by the Council of Higher Education (CES), the Civil Engineering degree is structured with 47 subjects and an estimated 200 students per cohort under the face-to-face modality (UTM, 2017).

From the review of the curriculum, it is clear that of the 6,480 hours that make up the 9 semesters of the degree, 57% correspond to student autonomous work and 32% to teaching work.

In accordance with the academic regime regulations, the principles of the academic curricular organization are developed through a system of credits/hours, focused on the student to achieve the competencies and objectives established in the subject. Table 1 shows the semester distribution of the subject.

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Table 1 shows the semester distribution of the subject.

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantities (hs)</th>
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<tbody>
<tr>
<td>Weeks</td>
<td>16</td>
</tr>
<tr>
<td>Credits</td>
<td>3</td>
</tr>
<tr>
<td>Hours</td>
<td>144</td>
</tr>
<tr>
<td>Hours/Credits</td>
<td>48</td>
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<tr>
<td>Autonomous learning hours</td>
<td>80</td>
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<tr>
<td>Learning hours with teacher</td>
<td>48</td>
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<tr>
<td>Practical learning hours</td>
<td>48</td>
</tr>
<tr>
<td>Pratical learning hours</td>
<td>16</td>
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</tbody>
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De lo revisado en el sílabo, los resultados del aprendizaje se resumen a:

- Reconocer y diferenciar las diferentes obras hidráulicas en captaciones, conducciones.
- Calcular sistemas de captación dadas las características hidráulicas de la obra.
- Aplicar criterios de la Mecánica de los fluidos.
- Calcular sistemas de conducciones cerradas en serie, paralelo, y en redes.
- Diseñar obras de conducciones de flujo.
5 DIAGNOSIS

Although the teaching-learning process according to what is described in the syllabus is based on the autonomous work of the student and that the teacher makes efforts to make that happen, the teaching of the subject is developed in a traditional way: the teacher occupies the center of the process through the dissertation of master classes whose contents are the theoretical foundations of the topics to be discussed, followed by the resolution of a typical practical exercise, using the blackboard or through a projector.

The same procedure is used to carry out the laboratory practices: after the teacher argues the theoretical foundations of the topic, the students, through specific steps, collect the necessary data from the essay to then apply the respective equations that will lead them to ratify the theory, a fact that is reflected in the respective report of the laboratory practice.

Independent work consists of solving practical exercises proposed by the teacher whose objective is for students to become familiar with the variables involved in the phenomenon and acquire skills in calculating them. As can be seen, it tends to induce mechanical and rote work with minimal possibilities for reflection and does not clearly encourage collaboration scenarios between students. Since the last century it has been suggested that it is not a correct practice, an educator must allow the intervention of the student knowing their practical experiences from the social environment to the knowledge they acquire reflexively (Freire, 2004).

The evaluations to which students are subjected are generally based on the resolution of practical exercises similar to those carried out in homework and/or in classes and are mostly considered as measurement tools and their results become indicators to promote the student from the semester. Thus, the application of only practical exercises is reduced to a mechanical treatment of content, in this sense there is a risk of generating superficial and mediocre work (Brunner, 2012b).

The practical exercises referred to in the previous paragraph are mostly abstractions or simplifications of reality, which study isolated phenomena and do not fully integrate the social and economic problems of the environment. The perception and imaginary that the student builds about his/her context throughout the course and in general the degree is also partial, and his/her contribution is not significant for relevant training. A problem linked to this separation between the context and the evaluation
procedures is the loss of elements that structure a true analysis by competencies, a situation that leads to lack of definition.

This separation between the context and the evaluation processes was accentuated during the virtual modality implemented at the beginning of the pandemic when uses of new technological tools such as videos and virtual forums were incorporated. The prevalence of practical exercises as an evaluation procedure in this period shows that the in-person evaluation was transferred to the virtual modality with certain nuances, in some cases there has been no evidence of the use of technology to diversify their evaluation practices, by only transferring what that had already been planned in face-to-face classes and set up the materials and activities in the virtual classroom (Jiménez et al., 2022).

The evaluation procedures used by teachers are aligned with the objectives and results that appear in the syllabus of the subject, which shows that there is compliance with the planned planning. In this way, the problems mentioned in the evaluation procedures in no way fall entirely on the responsibility of the teacher since this absence of problems contextualized with the socioeconomic environment are also expressed in the contents of the syllabus, and in general in the structure of the the curricular framework that conceives teaching-learning as the treatment of isolated processes (Viramontes & Viramontes, 2021).

The student profile is generally characterized by submitting to the proposed evaluation procedures, which denotes a passive and only receptive attitude on their part, without being aware that the knowledge received is punctual and fragmented, disconnected from their environment (Freire, 2004). This means that, despite the fact that the hourly distribution of the academic load is focused on autonomous work, there is still an unconsolidated process of the student-centered education model, and little approach to the construction of reflective and critical thinking.

Currently, the education model must be focused on learning because education is the basis for the development of the subjective process that each individual goes through to build their knowledge (Alvarez, 2007), this experience must be known by teachers in order to change his teaching style.

The problem is accentuated because the teacher's profile is characterized by an absence of professional training in the area of pedagogy, sometimes, with delays in the exercise of abuse of power in the evaluation process by the teacher, the responsibility for failures falls on the student (Santos, 2016). The evaluation procedures used in the subject,
with a view of only measurement, isolated from the social context, are not sufficient to guarantee relevant comprehensive training with critical thinking and are part of the vision of a specialized science increasingly distant from the real society problems.

5.1 PROPOSED INTERVENTION PLAN

Para lograr mejores resultados se expone un plan de intervención en la asignatura bajo un enfoque ecológico de la educación, con los objetivos de promover la construcción de la comunidad de aprendizaje para lograr la mejora continua, pertinencia y calidad del proceso enseñanza y aprendizaje (De Vincenzi, Marcano, y Macri, 2023).

La estrategia de intervención empleada consistió en realizar una deconstrucción de la asignatura, es decir, a partir del análisis y conocimiento del contexto se definen los objetivos pertinentes y con ello se plantean procesos de evaluación formativa que sirvan como método de aprendizaje. De este modo las actividades de cada una de las cuatro unidades académicas se alinean con los objetivos a conseguir.

Para lograr los objetivos propuestos la estructura metodológica consistió en revisar el marco teórico de algunas dimensiones y aristas que se observan en la figura 1, de las cuales se elaboraron las actividades concretas de cada unidad académica.

Figure 1. Some dimensions of the methodological structure

As can be seen, it begins with the content of the syllable and the structure of the curriculum as the fundamental element of the methodological structure.
The concepts of quality and evaluation are components closely linked to the configuration of a desirable education scenario; Quality is associated with improvement and evaluation guarantees quality. In this way, evaluation is the factor that drives desirable changes in the functioning of a system, and these changes are what ensure the permanence of quality (De la Orden, 2009).

The evaluation procedures that are currently used in the subject such as the so-called practical exercises, still maintain features far from the social and historical context, which induce a learning approach that (Biggs, 2005) calls superficial and that are characterized due to the memorization of content and the training of professionals who have not developed skills according to the context in which they operate, and even more so without achieving significant levels of social commitment.

The intervention plan proposed in this work addresses the learning process as what (Soler, 2015) called the route that the student takes to face their academic needs based on their motivation and the strategy chosen according to their environment, where Learning is acquired from the perceptions and motivations of the student and from the context where the activity is going to be carried out Biggs, (2005), in this way the students assume a degree of interest and commitment that allows them to achieve meaningful learning.

The teaching approach must consider the institutional setting, the contents to be taught and the ways of evaluating (Correa-Bautista, 2017).

The activities that make up the proposed plan aim to leave behind the unidirectional and at times imposing nature on the part of the teacher and induce the student to abandon their receiving role. This means creating conditions for the construction of a scenario where the teacher is the guide and the student is the main actor, with learning autonomy and critical and reflective capacity (Monroy Hernandez, 2013).

Following the idea of constructivism proposed by Piaget and Vygostsky who formulate active learning in which the student constructs their own knowledge, the activities proposed in each of the units encourage student participation in practical tasks and learning based on real problems to achieve critical thinking and creativity (Savery & Duffy, 1995).

It is then proposed that each group of students formed face a real problem and select a preferably rural community to propose a design of a water supply system.
according to the real circumstances of the environment. However, given the reduced period of time available to Bonk (2009), currently the use of technology and freely available computer programs allow us to approach the solution of the problem during the development of the subject.

In the work process, the teacher facilitates and motivates experiential learning and his or her role will be to accompany and provide feedback to the students in a task that constitutes an important tool for reflection, formative evaluation and continuous improvement in the teaching and learning process from a direct relationship of the student with the context that they will face during their professional life (Black et al., 1998).

The learning community is an interaction of activities in principle between the teacher and the student, mediating between them their own tools, from their roles and previously established rules, from their individual and collective visions, to meet the planned objectives.

5.2 FLIPPED CLASSROOM AND FACE-TO-FACE CLASSES

Contrary to the master conference and dissertation of the theoretical foundations, which are characteristics of the traditional education that is being implemented, in this case the teacher will obligatorily require the students to read and watch videos prior to the face-to-face meeting (Verón, Marín, & Barrios, 2021), in addition to optimizing time, this activity will motivate participation, reflection and active debate between students and teachers regarding the global and local problems of water infrastructure, contrary to the passive and receptive attitude that the student is currently experiencing. As an expected result at the end of the unit, the student will be able to critically analyze problems related to the topics covered.

5.3 COLLABORATIVE WORKSHOPS FOR SOLVING PRACTICAL EXERCISES

Practical exercises are abstractions of reality that distance the student from the socioeconomic context that surrounds him; However, solving these exercises is important as part of training in the use of mathematical and physical tools. But unlike the teacher solving an exercise unidirectionally, the formation of groups that collaboratively solve the exercises proposed by the teacher in workshop scenarios is proposed. As an expected result, collaborative and distributive work among students will be strengthened.
5.4 LABORATORY PRACTICES

As stated in the diagnosis, laboratory practices that are supposed to serve to verify compliance with physical laws become measurement tools intended for the calculation of results that separate the student from reality and are marked by the absence of analysis. Deeper (Santos, 2016). The innovation proposed in this activity (observation only) means that students concentrate on the analysis of the physical phenomenon so that they can reflect on the interaction of the variables that intervene in the practice.

As an expected result, the student, through observation, will connect with reality and overcome standardized practices, full of formulas and technical terms that distance them from reality (Cross, 1998). This author was an engineer who created flow distribution methods in water network systems.

5.5 CASE STUDY

As part of the activity that will strengthen contact with reality, the teacher will propose the study of a specific case in a community selected by each group. As an expected result, students will learn through their own means the comprehensiveness of social problems; will raise the problems and solutions generated from the technical inspection carried out by the group, a situation that will provoke analysis and critical reflection and will allow the development of professional skills.

As a task, the students will prepare a document with a proposed solution to the demand for water, which will be presented and given feedback collectively in plenary. The latter is a significant event that expresses real sociocultural exchanges that affect the role of both the teacher and the student (De Vincenzi, 2009).

Aside from the opportunity for students to develop their levels of competence, carrying out the case study strengthens the path of construction of good academic practices, favors the formation of study groups, extension of the classroom, improvement of teacher and student confidence, helps the materialization of various elements of expression, agreements and negotiations between actors, as stated by De Vincenzi, et al (2023), the progressive construction of the learning community is encouraged, in natural spaces where students will develop their profession.
5.6 EMPHASIS ON FORMATIVE ASSESSMENT

The rubrics adopted emphasize formative evaluation expressed in the case study activities, technical visit, workshops and laboratory practice that reach a percentage of 70%. This training is important in the training of the student fundamentally in the area of science teaching where there is an understanding of the central ideas in a discipline, as well as the development of scientific practices that demand the participation of students in the construction of their own knowledge (Talanquer, 2015).

5.7 LIMITATIONS OF THE PROPOSED ACTION PLAN

One of the limitations of the implementation of the plan would lie in the absence of pedagogical training and little experience of the teacher to develop work with groups in an interactive and collaborative way to promote learning community scenarios.

Assuming new work methodologies during the development of classes could affect the level of commitment of the actors if the traditional methodological structure that is currently applied and that was already described in this document is considered.

The increasingly increasing number of students at certain times would cause difficulty in managing the proposed workshops and feedback environments.

6 CONCLUSIONS

The implementation of the proposed methodological structure as a process can cause difficulties in the incorporation of teachers into the learning community; but with this, substantive changes can be achieved in the teaching and learning of the subject hydraulic engineering that can change as the need to move to new ways of teaching is understood.
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