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Research Article

DIDACTIC TEST BANK OF OIL WATER WELL

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ABSTRACT

This document presents the partial results that arise from a case study developed in the Higher Technological Institute of Tantoyuca Veracruz Mexico with students of the 6th semester of Petroleum Engineering, in which the role played by the students in an environment of learning-active-collaborative. The hypothesis that led the investigation was: Will the didactic test bench incorporate the student into a leading role in an active and collaborative situated learning system? The use of the methodology (Project Based Learning) and the question that guided the research gave light to focus the research and the reported findings indicate that these didactic-cognitive instruments have a leading role in the process of constructing the collaborative active learning of the student and allows the student to interact in real time with the variables in the study of fluid mechanics in the oil industry and bring the theoretical concepts into practice. For example, obtain data on flow rate, viscosity, density, depth, pressure, speed, hydrostatic, volume, among others. Space where the student participates actively using metacognitive processes, this type of strategies emphasize, in the questions posed by the initial conditions of the subject under study; and from these approaches the subject is developed on theoretical bases. In the end the student will not only have the fundamentals explained by the teacher but also their own, together to put them into practice. Action that allows the student the ability to discuss and rethink their previous hypotheses.

INTRODUCTION

The processes of globalization currently demand professionals with the capacity to solve problems, who make good decisions, creators of novel solutions and appropriate to the context. Currently at the top level seeks to develop new pedagogical strategies that allow the training of engineering professionals with the skills required by increasingly dynamic work and social environments. The new methodologies seek to promote the development of generic competences such as: learning to learn, organize and plan, analyze and synthesize, apply knowledge to practice, express oneself clearly orally and written in one's own language, critical and self-critical capacity, work collaboratively, capacity for initiative and leadership and know a second language (Schmal, 2012). In this sense, the impact of the new energy reforms in the system of higher technological education in Mexico demand professional skills of international stature. In accordance with these demands, the oil engineering career emerges, with the purpose of training engineers trained to apply the most advanced scientific and technological knowledge, in a globalized global context, preserving and improving the environment in all aspects.

It is necessary to emphasize that most of the institutions that offer this engineering do not have a laboratory equipped to carry out the practices requested by the study programs. Given this problem and identified opportunity is being proposed a research project called "Oil Water Well Didactic Test Bank; where it is intended to perform practices that will impact the subjects of basic sciences, engineering sciences and applied engineering in the study of the behavior of fluid mechanics in the oil industry.

The intention of this research is to propose a didactic-cognitive tool that gives students the opportunity to build an active learning process based on their own experiences that stimulate curiosity and develop competences (know-know-how-to-know). Offering the possibility to explore, manipulate, suggest hypotheses, make mistakes and recognize them, justify, argue. In this regard, Meza and Zamorano (2007) mention that Physics courses based on active teaching methods obtain better results than in traditional courses, since they include the use of

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teaching techniques based on research and empirical data instead of anecdotes The traditional pedagogy, based on the solution of precise and well-defined problems, together with the exposition of formal definitions by the teacher (Angarita, Fernández& Duarte, 2011, 2014) has been the method usually used for the training of engineers. However, the large amount of information available, the high degree of specialization and deepening of engineering knowledge, as well as the experience of professionals with the ability to apply their knowledge to the context, have promoted the incorporation of pedagogical strategies that promote the student as a subject active, responsible for their own learning (Rodríguez- Cepeda, 2016).

According to Inhelder and Piaget (1958), the stimulus to achieve conceptual development is to recognize that contradictions and inconsistencies exist between ideas, and yet science teachers concentrate their attention on the concrete, through the omnipresent laboratory exercises, offering scarce opportunities for students to be able to examine the underlying concepts. More often than you would wish, the teacher provides the conceptual framework, and leaves little space for the construction of personal meaning. The teacher is the one who exercises control over the identification of the problem, the generation of hypotheses, the experimental design and the methods to manipulate and interpret the data obtained through observation. What is expressed by Inhelder and Piaget provides a stop to the reflection on the conceptualization of the role played by laboratories in the training of engineers; to be considered as spaces where students can interact with the variables under study, collect data, perform collaborative work, apply theoretical knowledge to real situations; promoting the critical reflection of the contents, stimulating a significant learning and valuing the individual and group contributions.

In this article the appropriation of knowledge is based on the implementation of a cognitive didactic strategy that articulates the learning based on projects and problem situations based on experiments [... a problem situation allows the solution or the explanation of physical phenomena developed using the knowledge of previous experiences and fundamental concepts within a particular area ...]

Experimental session

This research considers the test bench as a didactic-cognitive instrument that allows the student to build an active learning process. Bolaños (2012) explains how the teaching and appropriation of knowledge of Physics-Mechanics of fluid subjects is markedly improved when, from situations and problems based on experiments, students obtain the solution or explanation to physical phenomena in the laboratory and consider to the laboratory of mechanical fluid physics as a pedagogical tool. Driver and Bell (1986) state that in order for the goal of science learning to be fulfilled, it is necessary to take into account the latest knowledge contributed by research on students' scientific knowledge about the acquisition and development of science. Concepts, especially the data that sustain that learning is an active process in which students construct and reconstruct their own understanding in the light of their experiences.

In this sense, the test bench is conceptualized as a space where students interact with the science located in context, where they can apply their theoretical knowledge to real situations, fostering collaboration, reflection, debate and research. A didactic tool that empowers students and teachers an active-collaborative learning process, in an environment of commitment and responsibility. The test bench will allow experiments and demonstrate the physical phenomena, carrying out the practices in real time in order to capture the attention and motivate the student to participate actively in the active learning process.

Problem solving is learned by confronting events, defining problems, experimenting with them, analyzing the variables that intervene and looking for possibilities that provide alternative solutions (Parra, Duarte &Fernández, 2014). Several authors have proposed active pedagogical strategies, as an alternative to traditional teaching, in which the student becomes the axis of the training process. Some of these strategies are: problem-based learning (PBL); project-oriented learning (AOP); Competency-based learning (ABC) (Vega, Portillo, Cano &Navarrete, 2014).

Problem Based Learning (PBL)

It is a teaching method characterized by the use of real-world problems established as contexts in which students develop their critical capacity and problem solving. The PBL revolves around a problem situation well posed, with a theme of motivating interest for the students that relates the object of study; where the solution allows the development of the competences that are to be promoted. This methodology seeks to approach the student to the solution of problems of the real world, which allows to focus the learning on the student, and to introduce in the teaching problems open and closer to his professional performance (Restrepo, 2005).

The process to use this methodology is: the problem situation is presented in context, the learning needs are identified, the necessary information is sought and, finally, the initial conditions of the problem situation are returned. The strategy of this methodology allows the student to move from the initial approach of the problem situation to its solution, working collaboratively in small groups, sharing learning experiences. Enabling the development of skills such as observing the environment, reflect and communicate ideas. This teaching-learning methodology seeks, through the teamwork of a small group of students, guided by a teacher-tutor, to address a problem related to their future professional performance, collected from the contextual reality, after a process of research propose solutions; the purpose is that during this process each one of the students participate actively, they can build a meaningful, pertinent, updated and contextualized learning (Painean, Aliaga& Torres, 2012).

Project Based Learning (PBL)

In project-based learning, students seek solutions to complex problems that demand challenges, usually over an academic period, applying the concepts and fundamental principles learned previously. Because the depth with which projects are treated means that a broad vision of knowledge can not be covered, it is necessary for students to be able to cover their possible content gaps (Domínguez, Carod&Velilla, 2008).

The PBL provides an active learning experience that involves the student in a complex project that demands challenges and is significant, through which it develops capacities, abilities, attitudes and values. It approaches a concrete reality in an academic environment, through the realization of a work project. The contradictions that arise and the ways to solve them, contribute to this object of pedagogical influences becoming an active subject. Likewise, project-based learning offers the opportunity to achieve significant knowledge by solving situations in the professional field. Project-based learning is a method that gives great importance to the process of investigating around a topic to solve complex problems from open solutions, or to the process of addressing difficult issues that allow the generation of new knowledge (De Miguel, 2005). The use of PBL as a teaching strategy brings considerable benefits to students. On the one hand, it motivates students to learn because it allows them to select topics that interest them and that are important for their lives, and on the other, it increases commitment and motivation, making it possible to achieve important achievements.

Lara, Rojas &Lujambio (2018) expose some benefits of PBL:

- Prepares students for jobs. Students are exposed to a wide variety of skills and competencies such as collaboration, project planning, decision making and time management.
- Increase motivation. Teachers often record increases in attendance at school, greater participation in class, and a better disposition to perform tasks

Phases of the methodology implemented

Phase I: Introduction. Definition of the situated-contextualized project, oriented towards the achievement of a product that will contribute to the formation of the professional competencies of the graduate profile. In this phase, reference is made to the motivation in the classroom to involve students in a formative process characterized by promoting learning with active intervention. The intention of this phase is to generate inclusive dynamics, capable of achieving that students develop competences in real environments, facing authentic problems that demand challenges, with the purpose in the student being protagonist of their own learning [... the teacher establishes a didactic contract, moment where the role, responsibilities and commitments of the actors in the active process are clear].

Phase II: Addressing. A didactic strategy is proposed that consists in carrying out a set of articulated group activities, analysis and discussion of the possible solutions with a beginning, a development and an end with the aim of identifying, interpreting, arguing and solving the problem. In this phase, the importance of the problem is recognized and highlighted, posing questions of the phenomenon before being studied. From these approaches it is intended to develop the subject under study, and add the theoretical bases necessary to address and solve the problem situation by putting it into practice. In this space the student will have the opportunity to discuss ideas and rethink their previous hypotheses to finish the active learning process with solid arguments.

Phase III: Planning. Establishment of achievable goals for the development of the project. In this phase the administration of the project is planned with the intention of programming the activities and those responsible to achieve the projected goals. This planning phase begins with the analysis of the oil engineering grid to detect the subjects that require practices [... physics, fluid mechanics, hydraulics, multiphase flow in pipes, pumping systems, instrumentation and control, among others ...]. A work team representative of the group called Engineering Staff is organized with the intention of the punctual follow-up of the activities that seek the development of the project.

Phase IV: Socialization (group discussion). In this phase of socialization and group discussion, it is a process of discussion, validation of the refinement of the schemes and approaches made in the previous phases. Its objective is to integrate students in an active-collaborative process and debate; where questions are built about the issues at stake and critical construction of reflections. The Engineering Staff team presents the sketches obtained and analyzes the relationships that external representations have that helped them to analyze the situation. The teacher plays the role of promoter of the exposition of the ideas to the problem, stimulating the participation of the students driving to establish hypotheses and justifications, until arriving at generalizations in the solution of the problematic. This phase supports the teacher as feed-back; appropriate time to rethink, if necessary, some strategies.

Phase V: Execution. Execution of the activities planned in time and form for the development of the project. First we will work with the brainstorming method, to sketch and capture the ideas, we trace the strategy of first building a model with the intention of externalizing the ideas and physically capture them in a scale model representative of the test bench. Second, prepare a lay-out with the required technical specifications with the intention of building an exploded view of all the elements that make up the test bench. Third, to quote the material and instruments required for the construction of the test bench and Fourth to build and install the test bench.

Phase VI: Evaluation. The evaluation strategy is social, formative, continuous and dynamic through a semi-structured and flexible rubric that assesses the continuous improvement and collaborative active learning of the student. It focuses on the student's actions and inclusion in the face of the challenges presented by the process of building their situated learning.

Phase VII: Communication. The strategy is to propose a challenge to the group for the diffusion of the project in participating in social student events for example technological innovation where they can spread their experiences of the process of active, collaborative learning based on situated projects.

Evidence of project-based collaborative-active learning

Substantive moments of the Methodology. The following figures illustrate and describe the moments in the construction of the test bench (study of the problem situation, brainstorming, first drafts, design, construction, installation and development of practices ...).

Figure 1 shows the evolution of the sketches made by the teams in the brainstorming activity coordinated by the engineering staff team around the initial ideas of the test bench. Moments that express the thoughts of the students ...

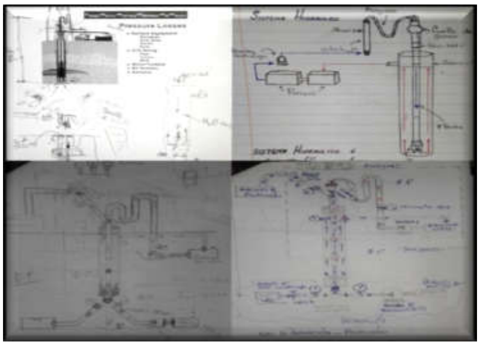

Figure 1 Student sketches brainstorming, debate and collaborative work

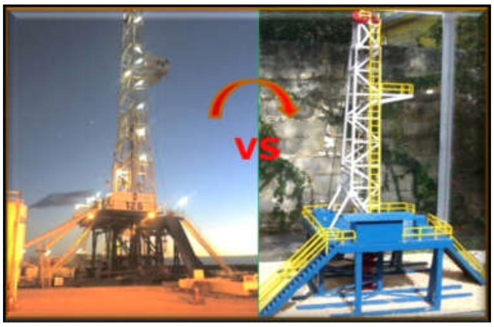

Figure 2 Scale model of the test bench VS oil water well tower

Figure 2 shows a scale model representative of the test bench tower, with respect to a real tower of an oil water well. The intention of the activity was to externalize, land and translate ideas for the design and construction of the test bench.

In Figure 3. The test bench assembly is displayed. This activity is very significant for the students, since they see the fruit of the process of construction of their active-collaborative learning. Moments where they see their ideas materialized, face challenges in the assembly process and issues that require rethinking their ideas, actions that demand collaborative work, analysis, reflection and decision making to continue with their task, and if necessary restructure to continue until finished homework.

Figure 3 Test bench assembly

Figure 4 Process of construction of collaborative-active learning

In figure 4. It is visualized in a test bench finished in its first stage, this moment is very significant for the students, due to see in the project their ideas reflected in the initial sketches physically represented in something real. This figure shows the transformation of the brainstorming, the thoughts embodied in the paper (sketches) to bring them to reality in the construction of the test bench, and compare it with a real tower of an oil water well

Evidence of the development of didactic test bench practices.

Practice 1. General knowledge of the operation of the test bench

Didactic intention: To know the parts, the operation and the security required for the use of the test bench.

Procedure: First, proceed to verify that everything is connected and installed correctly (Figure 5), conditions of pump n° 1 (drilling mud), pump 2 (reservoir-oil), compressor 1 (reservoir-gas), operation of pressure gauges, valves directional control, connections of hoses without leaks, levels of deposits (1 and 2), use of safety equipment (lenses, overalls, gloves, harness, boots with cap). For this practice, the start checklist is used.

Figure 5 Check list of test bench start

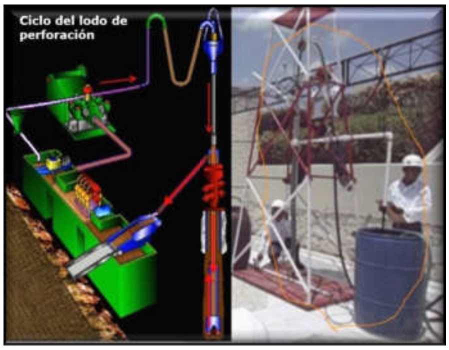

Figure 6 Drilling mud cycle

Practice 2.Drilling mud cycle.

Didactic intention: physical interaction in real time with the test bench.

Procedure: Interact with pump 1 (drilling mud dam), check sludge level of sludge dam 1, check the directional control valve, energize pump 1. Drilling mud is pumped to the bottom of the well, medium of the drill pipe and returns to the surface by the space between the pipe and the wall of the water well (annular space). The mud cycle is carried out by igniting the sludge pump 1 with a pressure of 20 kpa. With the intention of having a moderate flow of drilling fluid and observing the controlled cycle. It should be noted that in this practice there must be coordinated teamwork when interacting with the instruments and adequately controlling the drilling mud cycle. In Figure 6 the cycle is displayed.

Practice 3. Control cycle of an oil water well

Didactic intention: interaction with the instruments to control the hydrostatic column of the water well.

Procedure: adjust the manometers of pump 1 (... drilling mud) and pump 2 (reservoir-oil) (Figure 7). It is important for students to keep in mind that in oil water wells during the drilling, completion and maintenance stages there is a likelihood of an outbreak occurring. This is due to the imbalance between the pressure of the formation and the hydrostatic pressure of the control fluid. During drilling operations, a hydrostatic pressure slightly greater than that of the formation is maintained. In this way the risk of an outbreak occurring is prevented.

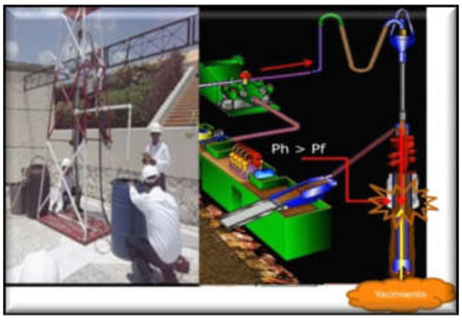

Figure 7 Control cycle of an oil water well

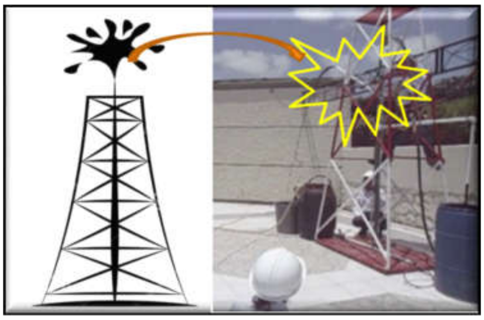

Figure 8 Oil water well decontrol

Practice 4. Decontrolling the water well

Didactic intention: interaction with the instruments to control the hydrostatic column of the water well.

Procedure: adjusting in the manometers the pressures of pump 1 (... drilling mud) and pump 2 (... oil-reservoir). In order to cause uncontrolling (Figure 8), the directional valve of the gas tank opens up and gives rise to a gas bubble. The intention of this activity is to simulate that we found some gas capsules, which would cause a lack of control in the deposit. Giving rise to the pressure of the formation (reservoir) will exceed the hydrostatic pressure and the outbreak will occur.

Practice 5.- Production process of an oil water well

Didactic intention: interaction with the instruments.

Procedure: the manometer of pump 2 (reservoir-oil) is adjusted and energized to transmit pressure to reservoir 2 fluid (which represents the reservoir). This activity (Figure 9) causes the fluid (oil-gas, water) to flow to the surface and transport it to the stationary tanks. The production of hydrocarbons is the process of taking out in an orderly and planned manner the crude oil that nature has accumulated in underground deposits.

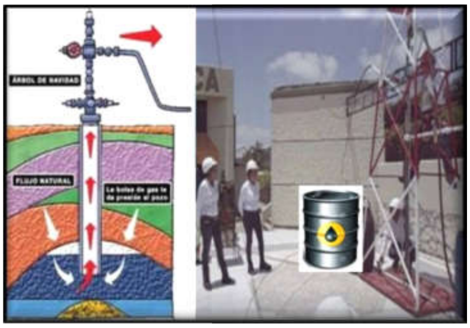

Figure 9 Oil water well production process

Figure 10 Participation in Social-educational events.

Practice 6. Communication- Socialization

Participation in the national student event of technological innovation in the local and regional stages in the area of social and educational innovation (Figure 10). With the intention of competing, communicating and socializing the significant learning situated and exposing the developed competences.

RESULTS AND DISCUSSION

The evidence reports findings, in a learning model based on projects located in the student's professional interest, an environment of common agreement in the classroom a kind of didactic contract; strategy that considers a leading role of the student of their own active collaborative learning. The intention of this methodology was to generate a dynamic, able to achieve in the students the inclusion and development of competences in real environments, facing authentic problems located that demand challenges.

The findings found during the development of the methodology at different times are discussed below.

Moment1, approach to the problem of professional interest, students accept the challenge demanded by the project "construction of the test bench", are involved in the projected activities, actively participate in the presentation of their first ideas (representative sketches of the project), discuss and defend their ideas, reach a consensus in an active and collaborative work to take the best option, the representative team "engineering staff" takes its role of the group's leadership. Moment2, project management, a representative scale model of the project is built [this activity exposes brainstorming, sketches with the intention of capturing ideas, debates, discussions and solution methods that allow to use cognition and metacognition in students, by rethinking hypotheses to reach a consensus on the optimal solution of the situation]. Moment, that externalizes the thoughts in students, when expressing their ideas in a model that represents a real tower of an oilwater well and to dimension the magnitude of the challenge of the project.

Moment3, socialization-group discussion, is a process of discussion and validation of the refinement of the schemes and approaches made in the previous phases [initial sketches, hypothesis, project management, others ...] at this moment the group collaborative work is observed in the students, in an active process of questioning the issues at stake and reflections, where the teacher has the role of promoter in the presentation of ideas, stimulating student participation and encouraging the establishment of hypotheses and justifications.

Momento4, exposes a formative, flexible, continuous and dynamic social evaluation process that focuses on the active-collaborative and inclusive action of the student in the process of building their learning.

Momento5, Social communication of the project, the challenge of this moment is the participation in social student events where they can share experiences of solution of the project, others ...

As noted Bolaños (2012) on the appropriation of knowledge of physics-fluid mechanics issues is markedly improved when, from situations and problems based on experiments, students get the solution or explanation to physical phenomena in the laboratory. It is important to clarify the discussion of the findings found in the different moments, the real-time practices placed lead the students to new adventures of exploration, to improve the understanding of science, to actively participate in their learning process, to experiment and analyze the data through the practices. Performing this type of simple experiments captures the student's attention, allowing to fix and appropriate knowledge for later applications.

CONCLUSIONS

The experimentation is intended to capture the attention and motivate the student, also generate a space where the student has the opportunity to interact with variables in real-time study, discover the explanation of the phenomenon that has been exposed, where the student actively participates using metacognitive processes. It should be emphasized and emphasized in this type of didactic-cognitive projects the importance of the initial challenge that arises around the subject under study; and from this approach the subject is developed with the theoretical basis, in the end the student will not only have the fundamentals explained by the teacher but also their own, together to put them into practice. Situation that allows the student the ability to discuss and rethink previous hypotheses. Activities that can be considered as a source of motivation to develop applied research in a particular area, encouraging the student to theoretical knowledge of the events of their daily lives and their professional experience.

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