

QUALITY TEACHING AT HIGHER EDUCATION INSTITUTIONS: TEACHING EFFECTIVENESS IN THE FIELD OF PHYSICS

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Abstract

It is presented one proposal for pedagogical intervention to improve the teaching and learning of physics in higher education institutions. The project is a training of 12 hours for professors concerning teaching and learning of Physics. The aims of the proposal are to identify the factors and conditions that favor learning, to concretize short, medium and long term pedagogical plans, as well as to train with the teachers participants the writing of pedagogical aims, the differentiated and strategic application of models and methods of teaching, to apply and to create evaluation instruments; all of it will be based on constructivist alignment and in SOLO taxonomy. This kind of project can be re-structured to other kinds of contents, such as Mathematics, History, or even a specific content of one subject, the Mechanics, in a course of Physics. This paper can be used as a guideline to establish a course to teach teachers so that the student's learning can be effective and profound.

Keywords: Pedagogical intervention, physics, higher education institutions, constructivist alignment, SOLO taxonomy.

1 INTRODUCTION

There is a significant lack of in higher education institutions, particularly in the field of physics, to strengthen the focus on promoting the awareness of the usefulness of training students who know how to design, design, implement and operate complex systems with high added value; to systematically train students in order to make them competent to perform the tasks proposed in the context of functional teams; in an integrated perspective, active and experiential learning scenarios.

The importance of pedagogical training for the quality of teaching is expressive, and the importance of responding to the individual needs of teachers in the scientific field of physics is significant, developing strategies that promote reflection on the pedagogical practices of teachers in the scientific field of physics and creating networks of discussion and sharing of pedagogical practices, planning concrete scenarios of promotion and dissemination of examples of excellence practices of teachers in the scientific field of physics. It is considered that the training of Higher Education teachers should be based on the following assumptions: To respond to the needs of teachers, to be based on teachers' conceptions about teaching and learning, to focus on improving teachers' competences, to create an environment in which faculty feel to develop skills, from what they already do, to value knowledge in practice, to practice and practice, not aim at the definition or standardization of "good teaching", not to focus exclusively on the acquisition of techniques. In many cases, the higher education teacher learns to teach for himself, which has produced a set of myths and fallacies about teaching in the context of higher education - such as teaching to master the content and quality of the teaching can not be evaluated. In order to decide on the processes and practices that it performs in the preparation of a study plan, in the management of the classroom, and in the promotion of useful social resources to the students, the higher education teacher often follows his intuition, between routines and experiences lived as a student. This observation learning, through prolonged contact with the teaching profession, will affect the understanding and its teaching practices. However, the adequacy of the teacher model does it yourself, it has been questioned. First, it is a model that does not always respond to the need to train graduates with competencies relevant to the professional challenges of the future. Indeed, teachers have an important role to play in students' academic self-regulation. However, this will require them, in addition to up-to-date scientific preparation, to provide adequate pedagogical training.

The teaching practices based on teaching methodologies seem to be ineffective in adapting the training of graduates to the new professional reality in which they will live, and which will require them, more than specific technical knowledge and / or valences, the ability to think critically, to work collaboratively in teams and to transform information into knowledge. The constructivist alignment

advocated by Biggs advocates the practice of interactive learning geometries and the building of effective opportunities for small group cooperation to discuss and deepen learning objects.

This project of psychopedagogical intervention has the following purposes: the creation of training teams in specific scientific domains and pedagogical research inter, multi and transdisciplinary, that allow the profitability of experiences of: sharing and reflection on experiences of teaching, learning and supervision in teaching higher; conceptualization, implementation and dynamization of learning communities; identification of new general and specific competences to learn, teach and supervise pedagogical experiences in the field of physical sciences; as well as the recognition and profitability of collaborative pedagogical tools. The objectives of this work are to promote conditions to learning, to help teachers to plan situations of teaching and learning, to specify the pedagogical objectives, to present them models, techniques and contents to approach, as well as instruments and types of evaluation. Thereby, we hope that this workshop can help to train teacher to perceive these mentioned conditions to improve the process of teaching and learning.

2 METHODOLOGY

This work is a project of training on physics, which can be adapted to others areas if necessary. Here we give the main coordinates to make this workshop happen, but the specific questions are not treated to give space to teacher from others areas that could use this material to improve the way they teach and how they perceive the process of teaching and learning.

It is planned that the course occurs in four weeks, each meeting of 3 hours. On the first meeting, the content will be: Levels of thought about teaching and learning; styles of learning; approaches to learning; principles of effective learning; preparation for an effective classroom management.

On the second meeting, it will be treated about: the components of a pedagogical plan; results of learning, objectives and competences; learning theories; pedagogical methods. On the third meeting, the trainer will talk about models of teaching; and on the fourth and last meeting, it will be talked about evaluation and learning.

Now we are going to describe how to apply and which components are necessities to each module. The trainer can use the presented topics to elaborate a material to use with the participant group.

2.1 First meeting

2.1.1 Levels of thought about teaching and learning

Here is important to comment the difference between passive and active learning. Level 1 is when the responsibility is the entire teacher's. Level 2 is when the focus is on the performance and competences of the teacher. Level 3 is when the focus is on what the student does. Teaching supports the learning.

2.1.2 Styles of learning

Second Honey-Mumford (1986), there are different styles of students about their learning, as the actives, with short tasks, here and now; the reflexives, that have to hear and observe, they to plan it. Also, there are the theatricals that have to re-evaluate systems and concepts, to absorb ideas; the pragmatics, that have to apply that knowledge on their own reality. For Felder and Silverman (1988), those characteristics of the students are related with the way they have more facility to learn: processing- active/reflexive; perception- sensorial/intuitive; stimuli- visual/verbal; comprehension- sequential/global.

2.1.3 Approaches to teaching

According to Marton and Säljö (1976), there are two types of learning: the profound and the superficial. On the profound one, the student criticizes new ideas, connects it with previous concepts. The students look for meaning; on the superficial, he/she memorizes the information, knows isolated facts, looks for least effort. Profound: transforming; Superficial: reproducing. For effective learning the teacher should:

- To encourage the students, defining achievable goals;
- To establish relations between new and previous informations

- To help them to clarify the value and utility of that content to his/her future
- To alternate the methodologies, appealing to directives, semi-directive and non-directive strategies.

2.1.4 Principles of effective learning

Paul Ramsden (1992) has identified, for the improvement of the Superior Teaching, some characteristics that the teacher has to provide them:

Interest and explanation; preoccupation and respect to the students and their learning; proper evaluation with feedback; clear objectives and intellectual challenges; independence, control and involvement; learn with the students.

2.1.5 Preparation to an effective classroom management

The teacher has to plan the subject, with the contents, objectives, pedagogical methods, evaluation and references; to plan the weekly activities, with specific objectives, selection of contents, activities; and also has to plan each lesson methods and pedagogical techniques, educative resources, evaluation's instruments.

2.2 Second meeting

2.2.1 The components of a pedagogical plan

The components are the objectives, the methods and the evaluation. The teacher have to take into account the who are his/her students, that he/she wants to achieve with the lesson, as well as what techniques, evaluation instruments and pedagogical resources to apply.

2.2.2 Results of learning; objectives; competences

To evaluate the results, objectives and competences, the teacher can use Bloom taxonomy, SOLO (Structure of Observed Learning Outcomes).

2.2.3 Learning theories

The teacher has to use strategies of teaching, with orientations and theoretical principles. We call it teaching models. These models can be grouped into bigger groups, and these are what we call teaching theories. The theories are divided in three: behaviourism, that defends that during the learning, the student changes his/her comportament, cognitivism, that defends that he/she changes his/her capacity of response, that is, acquires knowledge, and constructivism, that defends that knowledge is constructed.

During the training, the trainer has to talk detailed about every theory exposed here.

2.2.4 Pedagogical Models

These are the techniques of teaching used by the teacher. The pedagogical methodologies can be directives (expositive or demonstrative), semi-directive (interrogative) or non- directive (active). Each one has its positive as well as negative points. It is necessary to talk about it during the training.

2.3 Third meeting: Models of teaching

On the third meeting, the teacher will talk about some selected theories and methods of teaching.

2.3.1 Ausübel's Assimilation theory

The process of learning is called significative learning. For this to occurs, it is necessary that: there is a potentially signiticative material, a minimal content on the students cognitive's estructure, and the student has to be willing to learn it.

Based on Ausübel's theory, Novak (1979) created the schemes and diagrams to illustrate the idea of that theory; these are called conceptual maps, and area very used to expresse students' new concepts and schemes.

2.3.2 Cognitive Psychology/ Information processing Model

Based on acquisition, transformation and recovery of information. It is used on: perception, memory, knowledge representation, language, thought. About memory, there are three types, the sensorial one, the work memory and the long-term memory. The teacher has to pay attention on it in order to select, organize and integrate it to obtain learning.

2.3.3 Problem Based Learning

It aims the development of important abilities and attitudes to an effective professional practice, and also promotes the construction of knowledge. The main characteristic is the use of open problems, whose response we don't have. The teacher's role on this task is one of an advisor, a facilitator, mentor.

PBL uses real problems to encourage students to develop their critical thinking and to acquire knowledge about essential concepts of the area in question. With this technique, the classes are dynamics and motivating.

2.3.4 Cooperative Learning

Students work in teams to achieve a common objective. It is necessary: positive interdependence, promotion of personal interaction, individual responsibility, social and interpersonal abilities, self-evaluation in group.

The teacher has to plan each phase of work, has to explain previously the objectives, the way it works, the criteria of evaluation, the initial information, the basic resources necessities to do the task, to deliver periodical discussions, tasks of crescent difficulty, to establish methods of feedback, to secure the individual performance, to evaluate the process of learning, not only the results.

2.3.5 Reflexive learning

Students reflect about experiences, actions and decisions made. The involvement occurs through a practical problem to solve and to understand. It is important to cite and explain Schön's model of reflexive questioning, the model of Greenaway, Kolb's cycle of learning and the model of structured reflexion of Johns.

2.4 Fourth meeting: Evaluation

On this last day of training, it will be discussed about evaluation.

2.4.1 Evaluation and learning

According to Gibbs (2002), the factor that students have the biggest concern is the evaluation. Time out of class is used to study focusing the tests.

The teacher need to know if the student have learned, and it is important to focus in what they do and not in what the teacher does.

2.4.2 Evaluation's function

It offers a certificate of approval; it promotes, orientates and encourages learning. Evaluate means to analyse what the student does and to estimate a value to those actions.

2.4.3 Types of evaluation

There are three type of it: summative, that occurs in the end of the process; continuous, that occurs during the process; formative, that provide information that allows the student to improve his/her actions and production.

2.4.4 Techniques and instruments of evaluation (examples)

Observation: effective for affective domain;

Formulation of questions: cognitive domain;

Measurement: psychomotor domain.

2.4.5 Formative evaluation/ Communication of results (feedback)

This type of evaluation must follow these rules:

Clear objectives of learning;

The feedback must give information about the student and the respective learning;

Feedback must be used to reduce the difference between what the student already knows and the expected results of learning;

Feedback must be effective with its orientations.

2.4.6 Continuous evaluation and evaluation by test

The trainer can talk about the advantages and disadvantages of continuous evaluation, as well as evaluation by tests.

2.4.7 SOLO taxonomy and evaluation

To apply it, the teacher must define previously the level of approval, the items to be evaluated in each level, and finally, he/she must evaluate each response attributing them to the levels of the taxonomy.

For example, they must:

To do the interpretation of the problem, identifying the relevant elements;

To elaborate hypotheses to the formulation of the problem;

To do the mathematical formulation;

To perform the necessary calculus;

To evaluate critically the obtained results.

2.4.8 Closing remarks and the workshop synthesis

Finally, the trainer can evaluate the effectiveness of the workshop, as well obtain a feedback from the participants.

3 EXPECTED RESULTS

With this kind of workshop, we hope to reach teachers of Physics that don't have an effective formation on teaching. We hope also that this script can be used to train teachers from another areas. The specific contents are not treated here so that the material can be adapted to the needs of the reader and trainer, but it is expected that the trainer promotes challenges in teacher's areas during the workshop, giving examples of how they could work on class with their students, as specific problems of electricity using PBL, or mechanics using cooperative learning.

4 FINAL CONSIDERATIONS

This proposal of intervention in the training of teachers is based on the perception of the indispensability of presenting experiences to students of higher education, and especially to students of Physics, who are characterized by mutually corroborating each other, with a critical awareness and permanent questioning of the characters involved in the teaching-learning process about the pedagogical objectives of the different curricular units and their relevance in the mapping of the professional competences that are expected to be achieved by the graduate in Physics.

A motivational basis for this proposal was the building of experiences that foster, in a phased and critical way, the integration of the pedagogical practices and extra-physical experiences of the student of Physics, through activities that intentionally, deliberately and conscientiously implicate the concretization of design, design, implementation and operation of systems and products. Specifically in the particular case in higher education institutions offering training in the field of physics, it is justified the growing concern with the effective implementation of active learning strategies, in view of the required proficiency, skills and personal and professional attitudes of the graduate in Physics, namely: a) reasoning in Physics and problem solving; b) personal and professional competences and attributes; c) interpersonal skills; d) teamwork; e) communication; and f) designing, designing,

implementing and operating systems in laboratorial and non-laborarian environments. It is important to continue the intervention with the community of higher education teachers, in order to promote and operationalize the skills of critical analysis of the teaching-learning process, exploration and monitoring of their teaching practices. At the final moment of this work, we emphasize our belief in the usefulness of continuing our work with higher education teaching communities.

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