

ISSUES OF SCIENCE TEACHING IN HIGHER EDUCATION

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Abstract

This paper aims to propose some ways on how to improve the relation between didactics and science in the field of science teaching in universities. Educating young people in sciences is one of the objectives of a general reform of programs that has swept Higher Education in Albania, due to the Bologna process. But this reform was originally conceived as training for teachers or students rather as an interactive process between these two actors. This paper argues that training teachers with the didactics of science would enable students to acquire knowledge more actively and efficiently. From a socio-constructivist perspective this study analyzes the situation in which vocational education is in Albania as well as the teacher's role in helping students develop an independent intellectual thought. The results of this study are based on three sources: student questionnaires, teachers' interviewing and class observations. Data analysis reveals that it is essential for teachers to be professionally trained with innovative methods of didactic research. Their implementation will allow the selection of those practices in science teaching which will facilitate the students' knowledge acquisition.

Key words: active pedagogy, change strategies, didactics of sciences, teaching methods.

Introduction

After the 90s as a result of numerous reforms which included the entire Albanian society, Higher Education in Albania has been subject to dramatic changes, especially in the last decade. Reforms in the educational system include the implementation of the Bologna Process, 2003, the establishment of new faculties and disciplines, the creation of new degrees and the introduction of the universities to the accreditation process. The transformation of Universities not only into institutions of learning, but also into institutions of scientific research and services for the general public (Musaj, 2010), makes higher education an important factor in the Albanian socio-economical life since a nation's industrialization can not be conceived without human resource development and technology transfer¹. On the other hand, in all official international documents is emphasized the importance of defining today's Albanian society as "a society of knowledge" not just information. In addition, improving the quality of education is the sixth objective of EPT (UNESCO, 2005) and it clearly demonstrates the importance of this indicator for achieving socio-economical development nowadays.

Part of this reform is also the Polytechnic University of Tirana. Debates on the implementation of programs, harmonization and professionalization of education were very intense. However they lack in a unified reflection on teaching methodology and its application.

¹ In the last decade the establishment of the Ministry of Technology and Information (MTI, 2010) along with the Agency of Research, Information and Technology (ARIT, 2010), centers of excellence, brain-gain project, the use of Internet and Information networks, reveals that the Albanian government is striving for a strategy which expresses a unified vision on science, technology and information. Albania has already developed a National Strategy for Science, Technology and Innovation (2009-2015) whose objectives, which are in compliance with those of Higher Education (2008-2013), are considered as a priority to the comprehensive reform of the country's different economical and social structures (Boriçi, A : 2010).

That is why this study aims to investigate this problem beginning with class practices. The reason for surveying students and interviewing teachers was to understand the difficulties they encounter while learning/teaching scientific knowledge. As a matter of fact, the analysis of learning conditions as well as students attitudes towards the changes made in science teaching highlight the importance of training teachers in the didactics of sciences.

Problem of Research

The purpose of this study is to shed light on some pedagogical phenomena which could affect the increase of quality in scientific knowledge acquisition in higher education institutions.

When asked if they had willingly chosen to study in the engineering faculties, only 1.56% of students responded negatively², which demonstrates that sciences occupy a privileged place in the young people's choice of education. However, a high percentage of students, about 40.63%, did not answer to this question. How can this hesitation be explained? It should be considered as a sign of a conflicting attitude towards their choice. What could be the causes of their lack of motivation?

Research Focus

The didactics of disciplines is first of all a field of scientific research. It includes three directions: epistemology of referential knowledge (nature, history, and transposition), the conditions under which is accomplished the acquisition of such knowledge and the characteristics of didactic intervention. It relies on such methods as: observation, description, and experimental verification and it is regarded as a prerequisite for teacher's professionalism, as an analytical approach and a theorization of practices (Pastiaux, 1996).

This study, without pretending to be exhaustive, aims to analyze the difficulties that students encounter in obtaining knowledge. The analysis of students' perceptions on the teaching process would help in identifying and finding ways to overcome some of these difficulties. It mainly relies on the analysis of the psychological axis of the didactic system (Chevallard, 1985), i.e. it relies on the students' relation with knowledge, whose improvement inevitably depends on the pedagogical strategies employed by the teacher in the classroom (Reboul, 2001).

Handling and overcoming the difficulties faced by students during the knowledge acquisition process means to base teaching on their needs. On the other hand, establishing a student-oriented teaching methodology implies a concentration on the learning process. Knowledge is not transmitted; it is built by the students (Jonaert, 2002; Johsua, 1993) who must use it and develop their skills and competencies in various situations (Brousseau, 1998).

Drawing on these general principles there are raised the hypotheses which will be discussed in the article:

- Teaching and Learning are considered a process with a single outcome. They seek to increase students' skills in relation to knowledge and its use. Therefore, teaching methods inevitably influence the change in the way students perceive knowledge.
- As a result, the pedagogues appropriate training not only professionally but also didactically has an important impact on the quality of knowledge acquisition at school.

² Quite the opposite happens in other countries where there is a loss of interest of young people to study science and mathematics. Rapport sur les politiques, Forum mondial de la science, OCDE, Mai 2006, Retrieved 20. 12 2010 from www.oecd.org/dataoecd/13/60/39116773.pdf

Methodology of Research

General Background of Research

Under the curricular reform, the Albanian higher education is undergoing dramatic changes accompanied by a significant increase in the number of students and their heterogeneous level of knowledge. As a result, this situation can not be managed anymore by means of current teaching methods. This is the reason why, the teacher's role in transmitting scientific knowledge to the students is crucial. In fact, in official documents, teachers' pedagogical training plays a central role in their teaching activities. On the other hand evaluation of their teaching skills is an integral part of scientific qualification criteria³ in Higher Education, but the way these skills can be acquired is considered more a result of their personal experience in teaching rather than a pedagogical training in this area.

There have been conducted very few researches on science teaching for higher education in Albania and most of them are profoundly theoretical in character. This paper, from a socio-constructivist perspective, undertakes to discuss this problem commencing with the Polytechnic University of Tirana (UPT), which is the only university of its kind in Albania and one of the few that provides degrees in engineering⁴.

Sample of Research

The study was conducted at the Polytechnic University of Tirana. In order to get an idea on the changes disclosed by the sample, it was paid attention to the following features: faculty, the level of study and gender. The sample included 64 students of whom 48 were males and 18 were females. This proportion clearly demonstrates that male students are more numerous in number at this University. The participants were from different faculties such as Electrical Engineering, Mechatronics, Computer Science, Telecommunications, Electronics, Geo-informatics and Geo-resources. Furthermore, they belonged to different levels of study but the majority of them were in the Bachelor level (49 students) and only 15 were in the Master of Science level. This questionnaires' distribution was done in order to reflect the actual distribution of students at both levels which is in the ratio 6:1. The purpose of this selection was to obtain a wider generalization of the results and, in some cases, their comparison.

Regarding interviews, they were conducted with 10 university teachers aged over 35 and who had no less than 5 five years of work experience in the higher education. Furthermore they agreed to take part in this study and in this case the quality of the opinions was more important than the number of people being interviewed.

Instrument and Procedures

The method of data collection is primarily quantitative. However prior to the questionnaire's drafting, a structured interview was conducted with 10 university science teachers in order to reflect in the questionnaires even the problems raised by them. The purpose was to later enable us to compare data between the two groups of participants (students and teachers).

3 VKM, Nr.467, dt. 18.07.2007, <http://www.ligjet.org/>

4 Viewed from a historical perspective, Polytechnic University of Tirana originates from the Polytechnic Institute (1951). The latter joined the University of Tirana in 1957 and is related to the establishment of a public sector which still constitutes the basis of Albania's industry (mining, energy, construction materials, etc). The year 1991 marks the separation from the University of Tirana of the group of engineering faculties and the establishment of the Polytechnic University of Tirana, which consists of 6 faculties that train engineers in the following fields: information technology, electrical engineering, mechanical engineering, civil engineering, geology and mining and mathematics and physics.

- Quantitative method by questionnaires

The questionnaire was drafted with the help of Questionnaire Design, module 8 (Siniscalco, 2005). It consisted of closed-ended questions which took into consideration the interests and requirements that students demonstrate in receiving professional training at the university. Its aim was to highlight the difficulties they encounter in the knowledge acquisition process.

The questionnaires were distributed by the researchers and they were all completed by students. However they differ in their level of completion because there were questions to which the students did not respond.

- Qualitative method by structured interviews

Teachers' involvement in this study was done for the purpose of providing a new approach to the object of this study. The interview focused mainly on the methods they use in the classroom, their teaching aids, and the workshops they have recently attended. They were also asked to express their opinions on students' motivation and preparation in respect to the knowledge given to them.

Data Analysis

The survey was conducted in October 2010. The data collected from it were analyzed using a descriptive statistical method in Microsoft Access Program, whereas the interviews were subjected to a thematic analysis performed manually.

The questionnaires' analysis show that two phenomena may have affected data collection: First, the fact that reflection on teaching/learning activities through questionnaires is a new practice for the Albanian students. Second, they are suspicious about the impact that their opinion will have in changing the situation at school.

By comparing quantitative and qualitative data we seek to give a much clearer picture of the teaching process.

Results of Research

Having analyzed the statistical results we come to the conclusion that the main sources of difficulty in knowledge acquisition are the materials and the cognitive and communicative obstacles.

More than half of the students, 53.13%, think that their difficulties derive from high school. The lack of correlation between concepts, for 50% of them, continues even in higher education. Among the difficulties they run into when learning concepts, they also rank the application of a theoretical approach to knowledge, the low number of practical tasks they perform, the lack of rooms and laboratories as well as lack of facilities for conducting experiments. Furthermore, they experience difficulties even in understanding the science materials provided to them in English because not all students have a satisfactory level in mastering this language. The following table shows the students' interest in gaining professional knowledge and relevant skills that will prove to be helpful in meeting the labor market requirements.

Table 1. Students’ perceptions on knowledge acquisition.

Expectations towards academic learning	Difficulties	Overcoming difficulties
<ul style="list-style-type: none"> - Strong theoretical and practical bases - Experience, knowledge, practice - Job-orientation and connection to the real world 	<ul style="list-style-type: none"> - Mastery of scientific concepts - Inability to perceive the relation between subjects - Theoretical application - Lack of facilities and funds for conducting experiments - Disbelief in solving problems likely to be encountered while working 	<ul style="list-style-type: none"> - Larger theoretical application - Presenting concepts in real situations - More experiments and lab classes - More extra school materials and equipment

Even the teachers acknowledge that the main obstacles to the students’ knowledge acquisition are “significant gaps in the fields of science and language”. It is observed that the main deficiency is related to the learning techniques which rely on reproducing facts. The teachers say: “the students are not used to assimilating theory”. They have also noticed that students coming from vocational schools possess more practical skills than those who come from general high schools. This is what assists them in gaining knowledge more easily.

Regarding students’ perception on the teaching process, we found out that they do not prefer to be active. They expect to be given in details everything by the teacher even the learning materials.

The indicators related to students’ perceptions about teaching have been summarized in the following figure.

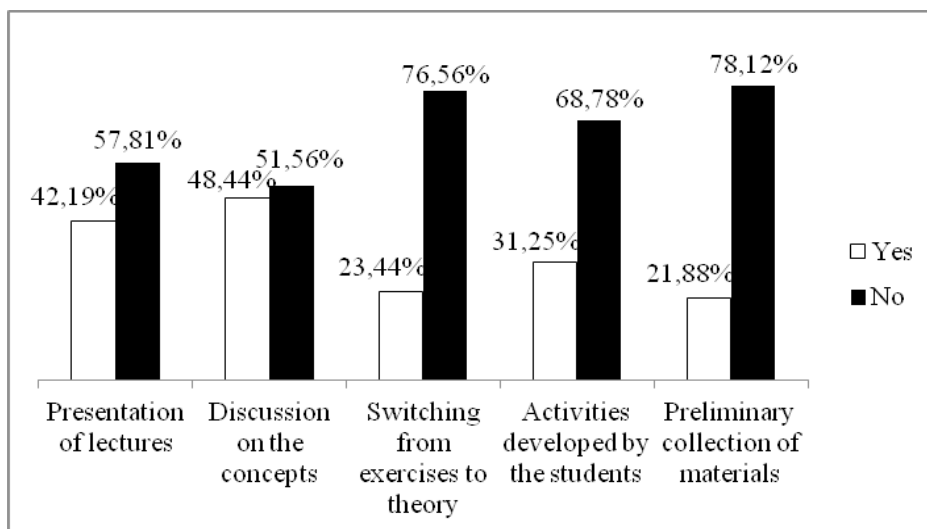


Figure 1: Students’ perceptions on the teaching process.

As it can be seen from the figure, students manifest resistance to changing their attitudes towards teaching. On the other hand, when asked what they would like to change in the way the lectures and seminars are conducted, students said they would like a more active learning. How can this contradictory attitude be explained? In fact, even teaching methods do not encourage a different attitude: only 20% of the lectures are delivered using discussions whereas the rest is organized in the form of an exposition.

In terms of professional development teachers point out that the only activity that has

contributed to their scientific education has been participation in national and international scientific conferences. They exhibit a kind of underestimation for their training in the didactics of sciences, by arguing that a good teacher in sciences is obviously a good one even in teaching. Their experience in teaching is related to older professors' method of teaching or to any specialization they have received abroad where they have seen how classes are organized there.

The comparison of the qualitative and quantitative data highlights the teachers' and students contradictory attitudes. Although they agree in principle to a different teaching in class, they still manifest resistance to changing their positions

Discussion

One of the hypotheses of the study is related to the impact of teaching methods on changing students' perception about knowledge acquisition. This impact consists primarily in changing the learning conditions.

The more knowledge is accompanied by its practical application and relevance to the real world, the more students' interest in absorbing it will increase. Indeed, students in the Master level recall more easily those instances in which the teacher presented concepts through examples taken from their personal experience at work. The same thing happens even while performing experiments or taking parts in laboratory classes where knowledge is presented inductively. The more consolidated the concepts learned in high school, the more naturally is accomplished their combination with new ones. Fragmentation of the knowledge gained in various disciplines does not allow students to arrange it in order to cope with professional life situations.

The level of English proficiency constitutes a barrier which affects very little the first level of studies because it is used very little (7.81%) when searching for documents. On the other hand it has a very big impact in the Master of Science level of studies.

To the cognitive difficulties are added those in assimilation and communication. It has been observed that students' expectations on knowledge acquisition are totally based on the teaching level and very few on individual efforts. Moreover, even the teachers do not encourage them to become more involved in building knowledge or in the discussion on it. Students' surveying highlights that they engage in reflective activities only when they have to do coursework. Whereas, mutual explanation of the ways of carrying out experiments or the ways of thinking on them in group or with the teacher is very low.

The reasons underlying these attitudes are related to a school culture where the teacher still continues to play a central role. His/her duty is to provide knowledge which the students will have to learn. Indeed, the asymmetry of their positions is quite comfortable but the establishment of a communicative pedagogical relationship would be beneficial for both of them. It would enable the teacher to test the effectiveness of his/her teaching aids. For instance, the use of PowerPoint which is considered a positive change does not appear to satisfy 67.19% of the students. This information would help the teacher to observe and reflect on the way he/she transmits knowledge to the student.

We have to admit that it is not easy to master the changes resulting from a new student-oriented teaching, especially when lacking the appropriate information and training on the various methods that could be used to adapt to the problems that might arise.

Conclusions

The analysis of students' difficulties shows that they feel unprepared to solve the problems they might encounter in the professional life. That is why redefining teaching/learning in order to develop a set of disciplinary and communicative competences would enhance their trust to face the real world. Consequently, the approach towards knowledge would be more

elaborate, more diverse and more beneficial to the students.

Student's resistance to change shows that traditional methodological skills in science learning are strongly entrenched in them. Moving from a learning model to another can not be achieved immediately, or without taking the students as the subject or object of this process. For this reason, the development of dialogue and interaction between the teachers and students would enable the latter to acquire knowledge more easily and effectively. On the other hand it would encourage teachers to reflect on their teaching practices in order to select and use more efficient models.

The growth of communication between universities regionally, nationally and beyond would influence a better understanding of various practices in the field of teaching/learning as well as in their correction or experimentation.

Well-trained young people in sciences directly contribute to a productive and competitive economy. Therefore, the quality of school's training directly affects how they will integrate into the professional life and contribute to the society in general.

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