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How Science is taught in the Secondary and High School Levels in Romania? *

Romanya Çapında Ortaokul ve Lise Öğreniminde Fen Bilimlerini Nasıl Öğretilir?

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ABSTRACT: This study examines how Science is taught in the secondary and high school levels in Romania. In order to identify how Science is taught, 82 teachers were assessed on their teaching methods, homework assignments and students' evaluation in physics, chemistry and biology. Further, teachers were asked to mention what type of lifelong programmes they have attended. The major finding in this study is that teachers make little use of experiments and scientific investigations, in the favour of theoretical learning. One explanation can be the fact that the highest weight in continuous teacher training was assigned to psychology, pedagogy, educational management and computer assisted instruction and reduced attention was attributed to the didactic training in science subjects. This investigation raises questions about the effectiveness of teaching Science in secondary and high school levels in Romania, and proposes some recommendations regarding teaching science and science teacher training.

Keywords: Teaching science, teacher training, students' assessment.

ÖZ: Başlıkta belirtilen suala cevap bulmak için, 82 fizik, kimya ve biyoloji öğretmenine öğretim yöntemlerine, ödev derslerine ve öğrencileri ne şekilde değerlendirdiklerine dair sorular sorulmuştur. Ayrıca, bu öğretmenlerden ne gibi sürekli oluşturma programlarına katıldıklarını da belirtmeleri rica edilmişti. Bu araştırmanın başlıca neticesi şudur ki, öğretmenler kurama ağırlık vererek, öğrencilerini bilimsel deney ve araştırmalara çok az derecede içeriyorlar. Bu durumun izahını fen öğretmenlerin başlangıç ve sürekli oluşturma programlarında psikoloji, pedagoji, eğitim idareciliği ve bilgisayar aracılığı ile öğrenim dalları en önemli yerleri tutmaktalardır. Fen derslerinin öğretim alanındaki hazırlıkları güncelleştirme gereksinime bu programlarda lazım olan önem verilmemektedir. Uluslararası uygulanan testlerde Romen (ve başka ülkelerden de) öğrencilerin yetersiz puan aldıklarını da göz önünde tutarak, bu araştırmamızda fen derslerinin etkiliğini sual altına almakla beraber, fen derslerini öğretme ve fen öğretmenlerini oluşturma sorunları ile alakalı bazı öneriler de ileri sürülmektedir.

Anahtar sözcükler: Fen öğretmesi, öğretmen oluşturması, öğrenci değerlendirmesi.

1. INTRODUCTION

The role of science and technology in students' life has become more and more important during the last decade. Bishop & Denley (2007, p.2) emphasized that "Teachers in general, but perhaps science teachers in particular, have to face new challenges all the time in both what they teach (because that is constantly developing and changing) and how they teach it".

According to Snoeck and Žogla (2009), teachers constantly have to update their knowledge base, to know how students grow, to incorporate technology in teaching, and to find the most effective teaching strategies that help students become autonomous and lifelong learners. Teachers must assume different roles in order to contribute to the development of students, to

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guide the learning process in the classroom, to encourage the development of learning communities and of connections between school and community (Snoek & Žogla,2009).

Teacher education has been highly influenced by traditional perspectives on teaching and learning in many European countries. Buchberger et al. (2000) have argued that "contemporary teacher education in the Member States of the European Union seems to be strongly influenced by some long-standing traditions. These traditions are made up of a blend of not always consistent and sometimes hidden assumptions, beliefs and opinions on the professional role of teachers and on the acquisition of professional expertise" (p. 13). However, even if some changes in teacher education and educational systems in general have been made across a high number of European countries, one of the main changes that should be implemented for helping future teachers to promote a deep and relevant learning in their classrooms is the school-based curricula. Van Velzen, Bezzina and Lorist (2009) have suggested that this change could be facilitated by increasing the connections between schools and educational institutions involved in teacher training. The main assumptions that should underpin the school-based teacher education are the problems with which a teacher usually confronts in the real context of teaching, more specifically in schools and classroom (van Velzen et al.,2009).

In Romania, after the fall of the communist regime, the evolution of educational system was marked by a number of changes in curriculum, textbooks, teaching strategies, teacher education and relationships among educational institutions and the economic and social environment (Apostu, 2009; Ciascai & Haiduc,2011; Iucu,2005; Potolea & Ciolan,2003). Researchers ascribe these evolution to the global changes in society, to the educational reform in all sectors, to the achievements of scientific research in relevant fields, to the adoption of the European and International standards of teacher education and of recommendations of international institutions such as the World Bank, the European Commission, and UNESCO, etc.

Potolea and Ciolan (2003) consider that the teacher training field has registered a slower development, marked by many minor changes, as compared to school curriculum, instruction and evaluation. They share the opinion of Vlasceanu and his colleagues (2002) who consider that teachers fail to apply the reform because they do not become familiarized with the concepts and methodological principles of the reform (ibidem, pp.288).

1.1. Initial and continuous education of the Romanian science teachers

Research has indicated that few undergraduate students choose to attend Science Universities (Hussar, Schwartz, Boiselle & Noam,2008) and that students' interest in science-related careers might be a major concern in many countries (e.g. Christidou,2011; Dillon & Manning, 2010; European Comission,2011; Simon & Osborne, 2010; The National Commission on Mathematics and Science Teaching for the 21st Century, 2000 as cited in Baram-Tsabari & Kaadni,2009).

In Romania, like in many other countries, the number of students interested in becoming science teachers has been in continuous decline (Ciascai & Haiduc,2011). In the last ten years, teachers, school managers, researchers, educational policy analysts and journalists have indicated the increasingly superficial scientific knowledge of students in the high school level (Miclea et al. 2007; World Bank,2007). Taking into consideration these shortcomings, Romanian Faculties of Science have changed their curricula in order to become more interesting and efficient. However, the number of those who choose these faculties has highly decreased, while the number of those who are thinking to embrace the teaching career in science has dramatically decreased.

In order to become science teachers, besides the studies in science, students have to attend a programme of initial teacher training. This programme includes psychology, pedagogy, didactics, optional courses and two semesters of teaching practice. Although students have the

opportunity to follow at the same time both the initial teacher training programme and courses of science faculty, the number of those who choose to become teachers is quite low.

Statistical documents of the Teacher Training Department of Babeş-Bolyai University indicate that only 49 students have followed in 2005 the initial teacher training programme in physics, even if the number of students in the Faculty of Physics was higher (73). In 2009, the number of those who have attended the initial teacher training in physics had further decreased to 29 students out of those 42 enrolled in the Faculty of Physics and in 2011 only 10 students have attended to the initial teacher training programme.

Regarding the continuous/in-service teacher training, there are a variety of training programmes that aim to improve teachers' competencies. These programmes are offered by accredited institutions in teacher training, such as Ministry of Education and subordinated institutions, universities, NGOs, professional associations and other international institutions. For Romanian teachers, it is mandatory to attend to training programmes every five years, because they have to face with constantly new changes within their field (The law of education 1/2011). Due to this variety of in-service teacher training programmes, a teacher has to attend, on average, seven courses in ten years (Apostu et al.,2009).

1.2. Teaching science. Theoretical perspectives and connections to literature

Research has shown that investment in teacher education is essential for increasing the general efficacy of schools (Greenwald, Hedges & Laine,1996; Handsen,2008; Santerre,2006) and that there are some fundamental principles that should guide the teaching process. The main principles refer to increase students' interest for lifelong learning, create a variety of opportunities for learning and apply knowledge and skills in varied contexts and settings (National Research Council,2000). Using these principles, teachers could help students to transfer their knowledge and skills from one domain to another, to put into practice their knowledge, to model their behavioural and attitudinal values, and to create the context for linking school activities to their everyday life.

The extension of scientific information has affected how science is taught in schools. However, students need time to learn and they learn best if they are engaged in active learning, if they deal with observations and concepts before terms and facts (Fraser and Tobin,1989; McDermott et al.,1994; McKeachie,1994; Tobin et al.,1994 as cited in National Research Council, 1997) and if they can connect what they have learned in school with what they encounter in their daily life.

In order to help students to deepen their understanding of new knowledge, besides using teaching methods focused on students, teachers should assign homework that support learning. Marzano and Brown (2009) and Vatterott (2009) suggest homework effective practices: pre-learning/doing homework that introduces new content, checking for understanding, practice to enhance procedural knowledge and skills, processing for refining learning, developing/extending knowledge and preparing students for evaluation. Doing homework has been shown to increase students' sense of connection between school and daily life (Warton,2001 as cited in Brock et al.,2007), therefore being an important variable in the learning process (Cooper, Robinson & Pattal,2006).

Another essential aspect of teaching and learning is assessment, since it allows teachers to understand what students learn/how deep they learn and to adapt lessons to the students' needs. In order to identify and understand students's performances, the use of both formal and informal assessments is required. A productive assessment helps students become aware of their (mis)understanding and to revise and improve their learning. In addition, reflection on practice supports teachers in identifying the difficulties that students encounter during the learning process.

1.3. Low science performance on international comparative studies in education – an alarm signal only for teachers?

In PISA (2000, 2006, 2009, 2011) and TIMSS (1995, 1999, 2003, 2007, 2011) evaluations, the performance of Romanian students was constantly below the international average (Noveanu, Noveanu, Singer & Pop,2002; Gonzales, Williams, Jocelyn et al.,2008; Martin et al. 2008; OECD,2010; Martin, Mullis, Foy, Stanco, 2012; OECD 2013). The TIMSS evaluation aims to assess „what students know" while PISA aims to assess „what students can do with their knowledge" (Martin, Mullis & Foy, 2008, as cited by European Commission, 2011, p.13-14).

In relation with these main interests of international comparative studies PISA and TIMSS („what students know" and „what students can do with their knowledge"), it is important to ask what science teachers value: the science results (concepts, definitions, relations) or the way the results are acquired (especially through experiments and scientific investigation). Taking into consideration that these assessments are organized for more than fifteen years without any significant changes in the under average results of some countries (e.g. Romania, Bulgaria etc.), we aim to find out if science teaching, homework, student assessment and Romanian training programmes focus on the same perspective as international assessments.

Taking into account these observations, the present study has been guided by two main questions:

1.How science is taught in the secondary and high school levels in Romania?

a. *How much emphasis is put on concepts and theory and how much on experiments and scientific investigations in the classroom?*

b. *How much emphasis is put on concepts and theory and how much on experiments and scientific investigations in homework tasks?*

c. *How much emphasis is put on concepts and theory and how much on experiments and scientific investigations in the evaluation process?*

2. What are the main lifelong educational programmes that science teachers have attended?

2. METHOD

2.1. Participants

Data for the present investigation were obtained from 82 in-service teachers in physics, chemistry and biology, who have completed a survey after the 2010 examinations for attaining the definitive degree ('on-the-job confirmation') and the didactic degree II (an intermediate degree) in science teaching, at Babeş-Bolyai University, Romania. Males have been underrepresented in the present study since only 9,8% of the participants were males, and 90,2% were females. A high percent of participants (67,1%) were Romanians and 26,8% of the participants were Hungarians (6,1% did not mention their nationality). The highest percent of participants were biology teachers (48,7%), but physics and chemistry teachers were also highly represented in the sample (29,3% and respectively 22%). The age distribution indicates the following categories: 37,8% under 30 years old, 31,7% between 30 and 39, 14,6% between 40 and 49 and 15,9% between 50 and 56 years old. Regarding teacher experience, more than half percent of teachers (58,5%) had between 1 and 10 years of experience. The most experienced teachers had 31 - 40 years of experience, but this was the case of only a slight percent of the participants (3,7%). The rest of the participants had between 11 and 30 years of experience (5,6 % had between 11 and 20 years of experience and 12,2% had between 21 and 30 years of experience).

2.2. Measures

The instrument used in the present study was developed by researchers and is composed of three parts. In the first part, the participants were asked to provide demographic data (age, experience, gender, specialization, nationality and the school level they teach). The second part of the instrument contains a scale with 30 items, measured on a 4 point Likert scale (from 4, very often to 1, never) and aims to assess the teaching strategies used by science teachers. The reliability indicator of the scale, the Cronbach's alpha, was .868. The items are structured according to three dimensions: teaching science, homework and assessment (Table 1).

Table 1: Sample of the Items from the Scale Used in the Present Study

Items	1-Never; 2-Rarely; 3-Often; 4-Very often			
Teaching science				
Students participate in an experiment or scientific investigation	1	2	3	4
Students work in small groups at solving problems	1	2	3	4
Students design experiments and scientific investigations	1	2	3	4
Homework				
Students identify applications for the content of a lesson	1	2	3	4
Students learn definitions and formulas	1	2	3	4
Students perform investigations and collect data	1	2	3	4
Assessment				
I assess students' knowledge through questions concerning the generation of hypothesis	1	2	3	4
Students' knowledge are assessed through questions regarding the design of scientific investigations	1	2	3	4
Students have to answer to my questions with explanations and argumentations, not with definitions	1	2	3	4

The third part of the instrument covers six dichotomous questions concerning the type of lifelong educational programmes that science teachers have attended, and one open question regarding teachers' opinion about the most effective teaching methods in science.

2.3. Procedure

Teachers who agreed to participate in the study were requested to complete the questionnaire at home and return it by the end of exams. Because physics teachers were slightly represented during the 2010 examinations (2 Romanian teachers), we decided to deliver online the questionnaire to physics teachers involved in a Curriculum Management Master Program at Babeş-Bolyai University. Thus, a number of 22 physics teachers have completed the questionnaire online, the majority of these teachers having a high experience in teaching physics.

3. FINDINGS

3.1. Teaching Strategies

During classroom lessons in science, students usually learn definitions and formulas, and resolve problems indicated by teacher (Figure 1).

Learning of definitions and formulas and solving problems are important in understanding various processes involved in explaining physics, chemistry and biology phenomena, but only if such learning is done with understanding. Students need to understand the definitions and formulas they learn, in order to be able to apply them in different contexts and to different problems they encounter in their daily life.

During science lessons, Romanian students often and very often have to identify connections between what they learn in science and their daily life (examples and applications), and to apply formulas and laws in order to solve the problems they encounter in their daily life.

This might facilitate the development of abstract knowledge and flexible representation of knowledge and also the transfer of learning from one context to another (National Research Council, 2000). Very often students work in small groups, and these activities help them establish a connection between school and daily life since a wide variety of activities and occupations involve collaborating and working with other individuals.

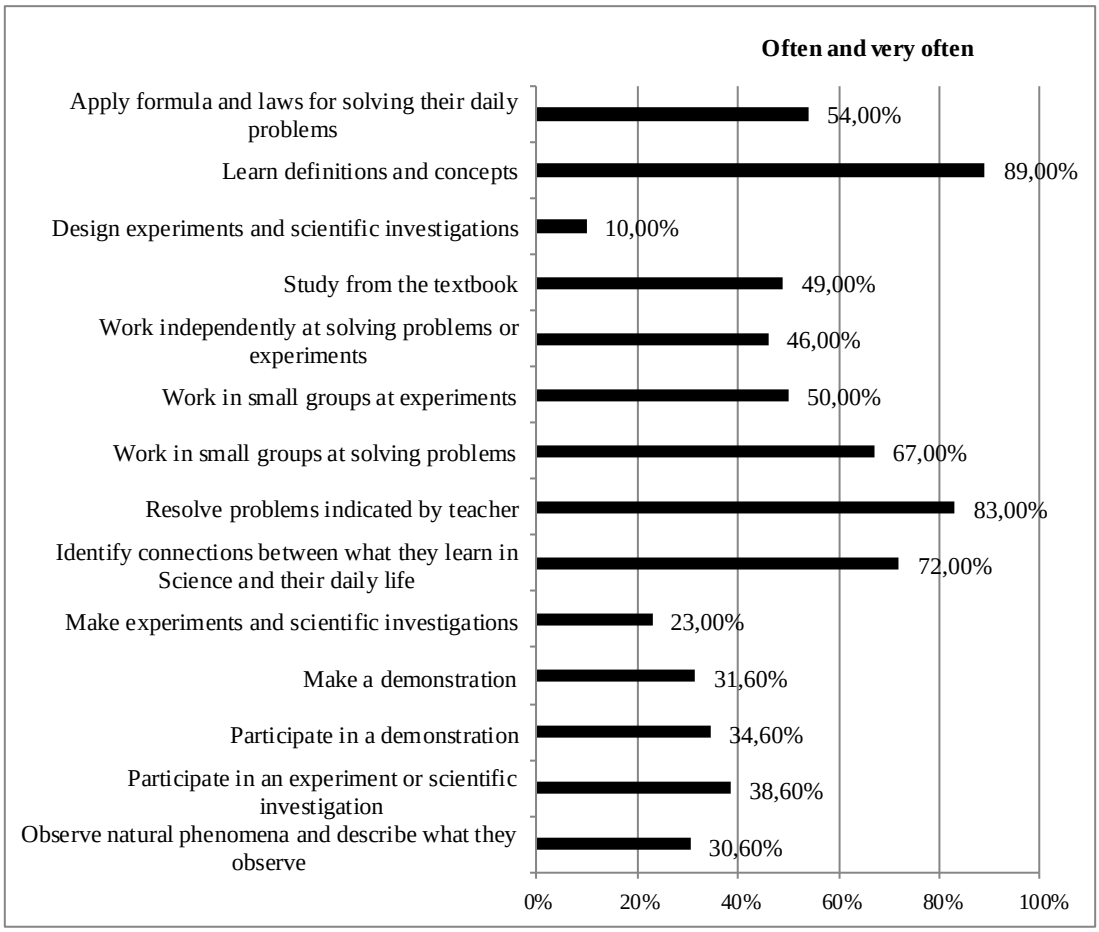

Figure 1.1. Classroom activities in teaching science

However, as can be seen from the figure 1, students seldom observe natural phenomena, participate in experiments, scientific investigations or demonstrations. Furthermore, students seldom have to design and conduct scientific investigations. Performing such tasks could increase students' interest in studying science and in careers related to science, and could also help students to better understand scientific concepts and phenomena.

Nevertheless, teachers from the present investigation believe that experiments and scientific investigations should be implemented during classroom lessons, even if they usually make little use of them when teaching science. This was revealed by analyzing the teachers' answers to the question "what teaching methods do you consider essential for an effective learning in science (physics, chemistry and biology)?". Most participants have mentioned that the most useful methods for teaching science are experiments, both real and virtual, scientific investigations and various active methods, such as projects, learning through discovery or educational games: "methods in which students can be involved, can be active, can do experiments and can learn by themselves" (physics teacher); "observations and investigations in

the nature" (biology); "trips, demonstrations, scientific circles and eco schools" (biology teacher); "active – participatory methods, taking into account common things from students' daily life, emphasizing the need to know the principles on which these things are based" (physics teacher); "experiments are essential in teaching chemistry" (chemistry teacher). Some teachers have mentioned that the most essential criterion in teaching science is to combine both traditional and modern methods, and to use explanation, demonstration, group work, experiments and projects: "combining traditional and modern teaching methods" (chemistry teacher), "modern teaching methods associated with traditional teaching methods, and teaching through interaction" (physics teacher), and "modern methods combined with traditional ones" (chemistry teacher).

3.2. Assessment

When assessing students, most teachers focus on questions that ask students to apply knowledge, to reproduce information, to explain facts, processes and phenomena and to argue opinions and ideas. Half of the teachers mentioned that they ask students to generate hypothesis and conduct scientific investigations, while half of the participants mentioned that they rarely or never use such methods in order to assess students' knowledge in science (Figure 1.2).

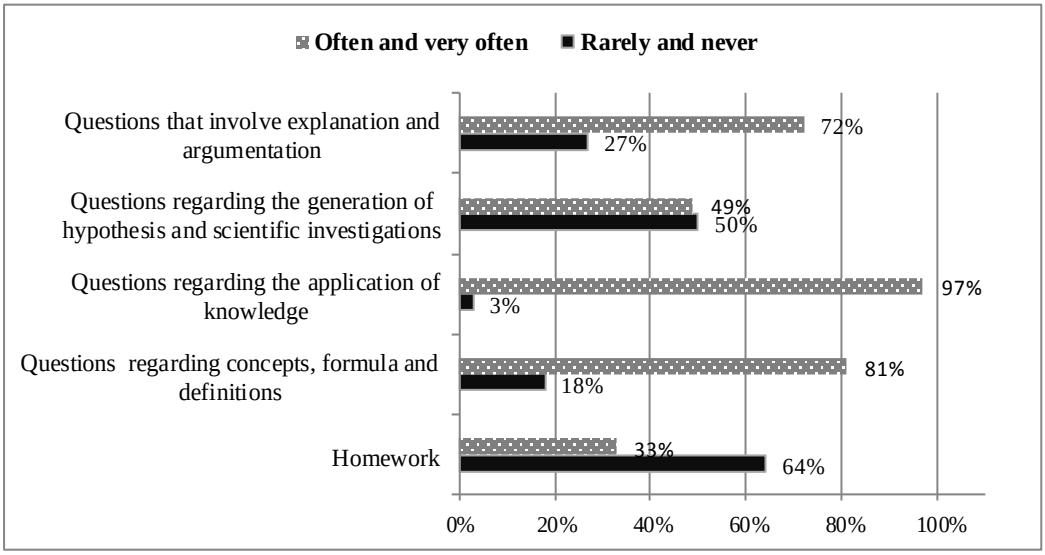

Figure 1.2. Students' knowledge assessment

Homework is assessed only by a third percent of teachers who participate in this study. This is not surprising, taken into consideration that usually homework involves practice of rote skills, doing exercise and solving problems (mostly by recalling past routines). Also, since students rarely design and conduct experiments and scientific investigations during school hours, even more rarely they have as homework to design and perform an experiment.

3.3. Homework

The participants at the present investigation mentioned that the most frequent tasks that students receive as homework are learning definitions and formulas, solving problems, answering to questions indicated by the teacher, identifying applications for the content of a lesson and studying texts from textbooks or additional materials. Students seldom have to write essays and reports or perform scientific investigations (Figure 1.3).

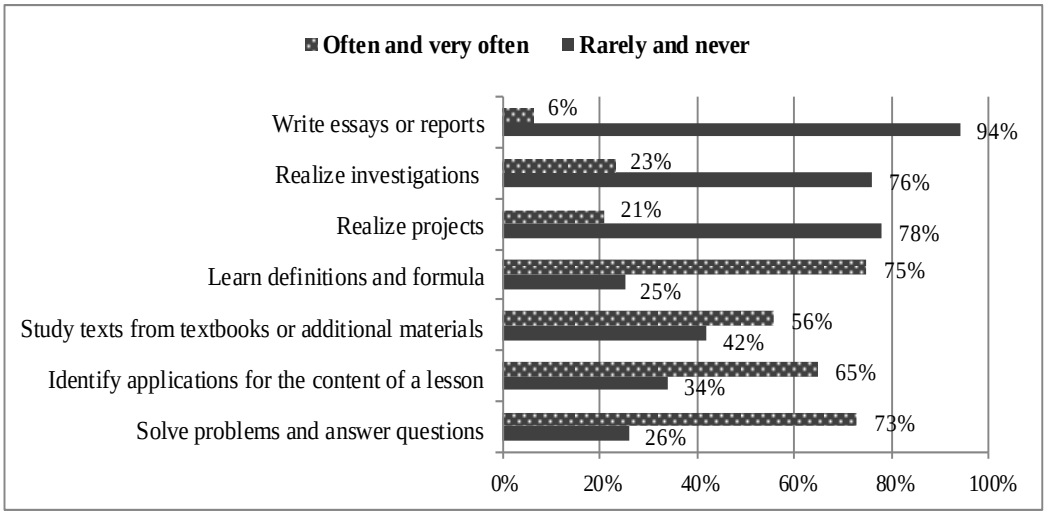

Figure 1.3. Students' homework

3.4. Continuous/in-service teacher training

The training programmes that teachers generally have attended were focused on the subject' content, teaching methods, developing students'critical thinking skills, new evaluation methods (e.g. portfolio), and science content. Teachers also mentioned that a large number of training programmes covers computer assisted instruction. Integrating the new informational technologies in teaching science is essential since technology is a part of students' everyday life and since school should prepare students for their career and create a link between school and community. As Eisenschmidt and Löfström have declared (2008), in many European countries, teachers get few benefits from programmes that aim to develop the informational technology skills of students.

Concerning the courses followed by teachers, none of these courses had the objective to prepare participants to develop hands-on activities, experimental activities or inquiry based science learning. Furthermore, although teachers were trained to develop students' critical thinking skills, they were not trained to reflect on their own teaching in order to improve it. Ghaye, (2011), Hillier (2005) and Norton (2009) emphasize the importance of reflection on teaching experience, showing that reflection transforms the perspectives on the teacher profession and change the current teaching practice.

4. DISCUSSION and RESULTS

The major finding of this study is that teachers make little use of experiments and scientific investigations, in the favour of conceptual learning. This focus on conceptual learning is in agreement with the opinion of Moreira (2011, pp.3) who considers that "concepts should be at the very center of all teaching and learning activities" because "without them all we call subject matter would practically do not exist". On the other hand, Gott and Mashiter (2005, pp.179),

citing Fensham (1985), consider that one source for student failure in learning science is the way practical activities are used. Gott and Mashiter argue that practical activities are generally used as „a means of enhancing conceptual learning rather than acting as a source for the learning of essential skills' (ibidem). In fact, conceptual learning might be the background in understanding the main processes and phenomena in science but experiments and scientific investigations are essential for a deep understanding and for transferring what students have learned in school to other contexts relevant for their daily life. This lack of preoccupation for learning science through investigations and experiments and for using knowledge in everyday life to develop new knowledge (by research, experiments, inquiry) could be an explanation of the low results in international evaluations, for both Romania and other countries.

The homework assigned by teachers focus on learning definitions and formulas, problem solving and answering questions about a specific science topic. Since these types of tasks are not pleasant for students, they generally treat homework superficially or refuse to accomplish it. Some easily experiments and scientific investigations based on hands-on science activities could be performed after the school programme. Having as homework to realize investigations in nature and museums would help students develop their interest in studying science and their sense of active and responsible learners. Such a perspective on homework could change the students and teachers opinions about the role of homework in learning (Vatterott,2009).

Teachers often and very often use collaborative learning when teaching science, and this might help students to become better prepared for their future careers and it may create a link between school and everyday life. Research has shown (Rogoff,1990) that a major difference between school setting and everyday life setting is the emphasis on individual or collective work and that everyday life involves collaboration with other individuals. For instance, a ship cannot be piloted alone; decisions in medical settings and discoveries in genetics laboratories involve collaborations between employees (National Research Council,2000,pp.74). Thus, the collaborative work in school settings can facilitate students' collaborative work in other settings, such as home, workplace and community.

As we have seen, most teachers do not use experiments and scientific investigations when teaching science and assigning homework. However, half of them have stated that they expect students to be able to generate hypothesis and make experiments and scientific investigations, and they consider experiments and scientific investigations the most effective methods for teaching and learning science. This might reveal the lack of resources at the school level or the lack of emphasis of the Romanian science curriculum on teaching science through experiments and scientific investigations.

There are some key recommendations which the Government and various stakeholders (Universities and other Teacher Education Institutions, Teachers' Unions and Teaching Councils) should take into consideration regarding teacher education: support the development of pre-service and in-service teacher training, promote the development of teacher training programmes, provide the necessary resources for actively involving students in learning science and implementing experiments during teaching science. Further, as OECD has emphasized in the book "Teachers Matter: attracting, developing and retaining effective teachers" (2005), there are some concerns regarding teacher education that policy makers should take into account, such as the attractiveness of the teaching profession, the development of teachers' knowledge and skills (including the reflection on own teaching practice), the assessment and employment of teachers and the maintenance of the effective teachers in schools.

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Uzun Özet

Bilim bilgilerin artırılması okulların içinde fen bilimlerin öğretim yöntemlerini etkileyerek öğretmen rolü ve öğretmen mesleğiyle ilgili değiştirmeleleri getirdi. Greenwald, Hedges ve Laine (1996) açıkmalarına göre, öğretim üyelerine ve de öğretmenler için yetiştirme programlarına yatırımlar okulların verimliği ve öğretim ve öğrenim kalitesi artırılması temelinde bulunmaktadır. Bu araştırmanın yoluyla Romanya çapındaki ortaokul ve lise okullarında fen bilimleri öğretim şekli ve fen bilimleri öğretmenleri tarafından katıldığı yetiştirme programları incelenmektedir.

Yüksel öğretim öncesindeki okullarda faaliyet gösteren fizik, kimya ve biyoloji 82 öğretmeninden bir anketin yoluyla biriktirildi. Adı geçen anket, Romanya, Cluj-Napoca Babeş-Bolyai Üniversitesinde organize edilen fen bilimleri alanında öğretmen ünvanları sınavları verildikten sonra 2010 süresince hemen gerçekleştirildi.

Romanya çapındaki ortaokul ve lise seviyelerinde fen bilimlerinin öğretim şekillerini incelemek üzere 4 seviyeli ile Likert merdivene göre 30 sorudan oluşan bir soru anketini düzenlendim (4'ten çok sık, 1'den asla). Fen bilimleri ders saatlerinde en etkili öğretim metotlarıyla ilgili öğretmenlerin fikirlerini açık bir soruyla anketin kapsamındaydı.

Fen bilimleri öğretmentleri katıldığı yetiştirme programalarını tespit edilmek üzere, ankete katılımcılarına adı geçen yetiştirme programlarıyla ilgili ikiye bölünmüş altı soruya cevap vermeye rica ettik. Araştırmaya katılmayı Kabul edilen öğretmenlere soru anketasını evlerine alıp inceleme süresin bitişinde geri vermeye rica ettik. Araştırma grubunun öğretmen sayısını artırılmak amacıyla Babeş-Bolyai Üniversitesi'nde Yüksek Öğretim Programındaki "Müfredatın yönetimi" adıyla katılan öğretmenlere de internet yoluyla gönderdik. Bu şekilde, araştırmaya katılan fizik öğretmenlerinin sayısı 2'den 22'ye artırıldı.

Araştırmanın esas sonucu şudur: öğretmenler bilimsel araştırmaları ve deneyimlerin yerine kuram teorinin öğretimini tercih ederler. Elde edildiği sonuçların, öğretim metotları, işbirliğinde çalışmaları (eleştirme düşüncesi dahil), bir ders alanının bilimsel içeriği (fizik, kimya, bioloji), öğretmenlerin değerlendirmesinde yeni metotlar ve fen bilimlerinin bilgisayarla öğretimi gibi fen bilimleri öğretmenlerinin, genelde, devamlık yetiştirme programlarına katıldıklarını olanaklı bir nedenidir. Öğretmenlerin cevaplarına gore adı geçen programlarda bilim müfredatı, bilim derslerinde etkili bir değerlendirme uygulması, deneyim yoluyla öğrenimin kullanılması ve bilim derslerinde araştırma metotlarını kullanmasına daha az bir önemi gösterildi.

Öğretmenler gösteriyorlar ki bilim derslerinde öğrenciler genel olarak kavram ve förmül öğrenerek öğretmen tarafından verilen problemleri çözerek, öğretmenlerin sorularına cevap verip istediği izahlarını vermekteler. Aynı zamanda, problem çözülmesinde küçük gruplarda çalışarak, günlük hayata doğan problemlerin çözülmesinde formül ve kural kullanarak bilim bilgileri ve hayat tecrübesiyle birbiriyle karıştırarak faydalanmaktadır. Bu çalışma şekli somut kavramlarının gelişmesini bir alandan başka Alana bilgileri geçiştirilmesini kolayştırabilir Milli Eğitim Konseyi, 2000). Araştırmaya katılan öğretmenler, doğal olaylarının fark etmeleri veya deneyimlere katılmaları öğrencilerden az istenilir (bilim bir araştırması veya gösteride) diye aktif bir şekilde derslere katılmaların yerine sadece seyirci rolünü oynar. Ayrıca, öğrencilerden bir bilimsel deneyinin tek başına gerçekleştirmeleri nadiren istenilir, hem sınfın içinde hem de evlerinde (ev ödevi olarak). Bu vazifelerin gerçekleştirmeleriyle fen bilimleri ve bilim alanı için öğrencilerin ilgisini artırılacaktır. Buna rağmen, öğretmenler tarafından gerçek veya sanayi şeklinde yapılan deyimler bilim derslerinde meyda getirmeleri gerektiğini sayılmaktadır. Deneyimlerin yanında katılımcıların çoğu fen bilimleri derslerinde kullanılan en uygun yöntemlerden müteakileri adı geçer: bilim araştırmaları, projeler, keşfetme veya eğitim oyunlarıyla öğrenim.

Öğrencilerin değerlendirmesi ise anketimize katılan öğretmenlerin çoğu bilgilerin uygulamasını isteyen soruları kullanılır, kavramlarını tanıtması ve formül veya tanımları da. Deneyimlere önem vermeyi

söylediklerine rağmen öğretmenlerden yarısı öğrencilerin değerlendirmesinde sadece bilim araştırmalarının adımlarını tanıtmayı ve kavramları söylemeyi dikkate almaktalar.

Deneyim ve bilim araştırmlarına gerektiği önem verdiği öğretmenler ve sınıfların için de yeterli şeklinde kullanmadığından doğan çelişki, deneyim öğrenimine gereken eğitm malzemeleri okullarda yokluğundan ve de fen bilimleri müfredatında deneyim ve bilimsel araştırmaları üzerine gerekli önem vermemesinden oluşmaktadır.

Ev ödevleri ise, soru anketimize cevap veren kişilerin yarısı tarafından control edilir/değerlendirilir. Sınıfın içinde görevlere benzeyen ödevleri ve görevleri bir neden olabilir: kavram ve teori öğrenimi, yeni bilgileri tanıtması, problem çözülmesi, metinlerin araştırması vs. Öğretmenlerin az bir sayısı araştırma veya raporları ve argüman yazıları hazırlamaları ister. Bu şartlarda öğrenciler ev ödevleri yapamazlar veya gerektiği önem vermeden.

Öğretmenlerin eğitimiyle ilgilendiren hükümet veya makamları tarafından takip edilmesi lazım: (üniversite ve öğretim üyeleri yetiştirmelerine katılan diğer kurumlar, sendikaları ve öğretmen konseyileri vs.): öğrencilerin gerçek ihtiyaçlarını tespit edilmesi ve öğretmen üyeleri için öğrencilerin ihtiyaçlarına uygun yetiştirme programlarını geliştirilmesi, uluslarası çapında verimli örneklere göre yetiştirme programlarını uygulaması, fen bilimlerinde öğrencilerin katılmalarını aktiv bir şekilde sağlanması, fen bilimlerinin öğreniminde araştırmaya önem vermesi.Ayrıca, Öğretmenlerin önemi: etkili öğretmenlerin alması, gelişmesi ve tutması (2005) adıyla OCDE tarafından yazılmış olan kitabına göre öğretim üyeleri yetiştirmelerinde siyasal oyuncuları tarafından önem verilmesi lazım birkaç faktor var. Şunlar bu: öğretmen mesleği cazibi artırılması, öğretmenlerin bilgilerin ve yeteneklerinin geliştirilmesi (öğretmen mesleği üzere eşleştirici bir bakışla dahil öğretmenlerin kendi öğretim yöntemleri dahil), öğretmenlerin ise alınması ve değerlendirmesi, etkili öğretmenlerin okullarda tutması.

Citation Information

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