

Comment

From the perception of science to the design of teaching materials

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Short introduction

All over Europe a number of countries have national curricula: France, Hungary, Ireland, Italy, the Netherlands, Portugal, Romania, Spain, the United Kingdom¹. In the majority of these countries common guidelines for conceiving a core curriculum – subject curricula, syllabuses, and textbooks – are followed. Science Education for Development of European Citizenship European project tried to offer an interesting and necessary perspective of approaching Science education in schools.

The present Project intends to present a new approach of this topic where the pupils' opinions and teachers' perceptions matter, specialists in pure Science, researchers in Science field and in the education field as well, museums educators and Science teachers being working together. In the third working group within SEDEC Project – the Teaching Materials working group (TM) – we try to conceive educational materials starting from the teachers' perceptions about teaching Science in order to develop their pupils' behaviors as European citizens. In the following we will show in which way we tried to reach to teachers' perceptions and what are our plans in terms of concrete categories of educational materials that can be developed starting from teachers' perceptions. To fulfill this goal two teachers' debates were organized in two countries of the SEDEC – France (with primary education teachers) and Romania (with secondary education teachers) so far. To understand French and Romanian teachers' points of view about Science lessons and their activity with students within classrooms, as debate results, in the following we will make a short insert on these two education systems in terms of curriculum organization.

Few words about French and Romanian curriculum and the educational materials issue

French² and Romanian³ curriculum frameworks are organized as a series of multi-year Cycles, during which students must acquire specific knowledge and demonstrate given competencies. In these two systems of education teaching of Mathematics, Physics and Chemistry is a point of pride and renown. For example, it is a global approach in which students are exposed early to a wide range of mathematical concepts: geometry, addition, subtraction and multiplication, algebra, fractions, the decimal system. Each year these mathematical concepts are expanded and students' comprehension deepens. Logic and expression are always prioritized.

Students in primary schools in France advance through the primary grades; they study many subject matters that are related to Science: Computers, Astronomy, Earth and Life Sciences, Geography.

In Romania, there is the National Curricula Framework⁴ that is not integrated any subject matter like Science, but just for the last two terminal years of high school education and not for every type of high school. In general, the subject matters are grouped in seven large curricular areas with a certain number of hours being allocated for each of them per week; one of them includes Mathematics and Science scholar disciplines. In this particular curricular area few subject matters related to Science field are grouped together: Mathematics, Physics, Chemistry, Natural Sciences, Biology and Geography. The main criterion that organizes these scholar disciplines is the Science core-knowledge package that is approached from different subject matters perspectives and that is explained to the pupils offering them a larger view upon the causes and the effects of particular Science phenomena.

In these two centralized systems of education there are some general rules that have to be respected in order to develop classes. For example, in Romania, teachers, including those whose subject matter teaching is related to Science education and is included in this particular curricular area, are advised from the Ministry of Education, Research and Youth level to respect and to teach all the themes that are included in the subjects curricula. To reach this national goal teachers invoke that they do not have enough time during classes to teach their pupils properly because in a short period of time they have to teach and not to debate or to discuss with their students about one scientific phenomenon or another. In their view there is no space during a lessons time for some proper explanations and for experiments with students.

The European point of view is that during Science classes calculating the correct answer is not sufficient; a student must explain how the answer was obtained, and why. Logic and the ability to articulate one's reasoning have to be emphasized in every grade and field. In these two national curricula and their textbooks the multiple-choice and true/false questions are virtually nonexistent as classroom exercises. Students are not thinks every time using their teachers' mental algorithms. The Meg's Case⁵ is relevant in this particular situation⁶: Meg, a second grade, field test teacher, is using an activity called "Enough for the Class," in which students consider whether the number of cubes in a bag is enough for each student in the class to have one. She gives them the following problem: In the classroom there are 26 students. There are 16 blue cubes and 17 red cubes. Are there enough for the entire class? Students quickly decide that there are enough for the class of 26 students and begin figuring out how many extra cubes there will be. Meg is taken by surprise when some of her students solve the problem this way: I can take 10 cubes from the 16 and 10 cubes from the 17 that makes 20. Then I need 6 more cubes, so I take away 6 from the 16. Now, I have 26, enough for the class. That leaves just 7 cubes from the 17.

To avoid this situation SEDEC Project proposes a new approach in conceiving educational materials by Science teachers and a teachers course afterwards that exemplifies for these category of teachers how to organize their lessons.

SEDEC new approach

Within the SEDEC Project the activities are organized in three main directions of work that will be developed in the relation one with each other: a) Perception Group activities: a survey has been conceived and questionnaires to 4th and 8th forms pupils and to teachers that teach these categories of students have been administrated (survey activity); pupils were tested by their drawings to see their perception over Science; and conceptual maps of Europe were made by pupils and by teachers; b) Database Group: in this Database the intention is to organize many information, projects and other useful knowledge very utile to be used during Science lesson by teachers and their students; this can be a useful instrument for teachers; c) Teaching Materials Group: that will create some categories of teaching materials for being used during Science lessons and to make a course-proposal for teachers that teach Science issues, even if they have different specializations like Physics, Mathematics, Chemistry, Biology.

As we can see even only within Teaching Materials there was about conceiving concrete educational materials for classroom activities during Science lessons, all other activities developed within the other two main working groups of SEDEC Project are complementary and help educational materials to be designed. Some of the materials will be developed on the basis of the results of the survey: figures of scientists. The aim is to encourage inquiry learning and first-hand experience of evidence of the history of science as well as of scientific phenomena for the development of knowledge, skills and abilities for building a lifelong familiarization with science and technology. Another will use Database instrument and other will start as a didactical methodology being conceived on the Science teachers' perceptions about being a good European citizen.

SEDEC Science teachers' debate findings

As we mentioned two debates were organized with Science teachers, in two countries where two SEDEC partner institutions exist: France and Romania. These debates were important to have teachers' perceptions about teaching Science and in which extend this topic is related to developing European citizenship behaviors on students. Also, we wanted to see if the information used during Science lessons

are provided exclusively by school lessons or in partnership with other local, national or international institutions that develop educational activities on this topic.

Another interesting aspect was that the debate organized in France⁷ joined together Science teachers from primary education that in the meantime in Romania⁸ the debate included Science teachers at secondary education level – more exactly teachers that teach in Gymnasium (5th to 8th forms).

In this article we will present only few Science teachers' perceptions. As an important aspect teachers' perceptions in these two countries, without regard to origin country, were almost similar. From their point of view to be a good European citizen means: to be opened to the other cultures, from which we accept and share the rules of life that leads to exchange; to communicate in other languages; to surpass national identity; and to provide solidarity and mutual assistance.

The most interesting answers were related to the terms/ the way of describing the relationship between teaching Science and developing the European Citizenship during classes. Here there were significant differences between the French teachers and Romanian teachers' points of view. The French teachers mentioned that the relation between Science and the European citizenship is initially well perceived in certain topics related to ecology, to resources management – e.g. the waste issue. Also, the French teachers mentioned that: the scientific knowledge and the historical inheritance of sciences must be shared, the successes clearly shown; the European diplomas, the studies in the other countries are important; and the behaviours induced by the scientific activities are to be considered on a large scale, like consequences of the actions of each individual, and international collaboration, must make it possible to better solve the problems. The Romanian teachers' first impression is that this relationship as it is in the textbooks and in Science subject matters curricula is not very well defined and developed. Only during Science lessons teachers can point this relation and can give some examples of good behaviours, together with their students.

In terms of educational method and Science knowledge that students are manifesting their interest for both groups of teachers mentioned the active learning⁹ principles like the most efficient in developing Science lessons. The Science teachers from both countries underlined that educational methods must make it possible to the pupil to start from concrete problems, in relation with everyday life. The pupil needs to be active: sensory handling, observation, groping, and experiments, manufactured things in a context can be like a game. The educational methods must make it possible to the pupil to take part in debates, not to fear to be mistaken. The carrying topics are matter and life, solar system, electricity, technology. As our French colleague, Etienne Bolmont, pointed out in his transcripts of the French debate, "the class must open towards the scientific world, make scientists come to the class, visits of laboratories".

In terms of other organizations developing educational activities related to Science field, French and Romanian teachers nominated few institutions like: places of cultures – museums; places of science - universities and research laboratories; organizations of assistance for the scientific contents - partnership with students of the high schools, the general council. As a plus, French teachers' answers quoted: institutional information centres (CPIE and Agencies of Water for water, « Côté Piles » for the problem of the batteries), of nature conservancy: WWF for the environment; European organizations (Erasmus), teaching assistance with "La main à la pâte" - CODES (education for health); organizations of social assistance - ONG, UNICEF; organizations of assistance to the exchanges between country - OFAJ; bilingual tools - scientific works. Romanian teachers' pointed out the importance of school parents' associations that can organize and sponsor all kind of activities that are developed for their children' advantage.

Short comments at the end

With respect to Teachers activity in the classroom the added value of the SEDEC Project consists in two main points of view: on the one side, the teaching materials that will be developed within this Project will take account and will use the results of questionnaires implementation and of the students' drawings; on the other side, some debates were developed mainly in two countries to catch the Science teachers' perceptions about their activity into classroom. In a few words, the teaching materials will use the Perception Group materials through the analysis of some items from the teachers' questionnaire and will use the Database in terms of didactical materials and of the didactical methodologies posted on the SEDEC site. Also, these materials will be designed according to Science teachers' opinions presented during the debates. Even it sounds great as a goal for the project it is a difficult task to be fulfilled.

This new approach of designing educational materials and of developing classroom activities generates new questions for the SEDEC partners being involved and it makes us thinking of possible answers. During debates teachers explained in concrete terms their view upon the relationship between teaching Science and developing European citizenship behaviours for their students. For example the French teachers mentioned that is a bond between science and social presentation of sciences. “How to explain to the children that the raised problem is European: Pollution does not have borders. Sciences are occupied with the everyday life, they are accessible, useful and they can modify our behaviour (« to open a water tap »), rather than to take into account the great projects. Also, the distribution of electricity extends beyond the borders, and the breakdowns abroad can have effects in France. There is a network between the countries. It exists an European standard for the start-up of the air-conditioners.”

Students` curiosity is to be supported. The children must become aware that their knowledge enables them to be actors and decision makers as for their future. Specific Science instruments and scientific approach over the natural world around us - observation and experiment are means of understanding and of respecting – help us to understand things better and to behave in accordance to. There is a need of an opening to the scientific activities to the world which surrounds us, to the everyday life to make pupils like sciences. This opening must allow exchanges between schools in particular.

Within SEDEC Project all the partners try to find concrete educational methods and didactical methodologies to develop this new approach over teaching Science related to the European citizenship issue. Classroom scenarios for Science lessons according to active learning principles, innovative didactical methodologies starting from Survey findings there are only the starting points for TM working group.

Notes and references

¹ As an important source for European education systems and their curriculum organization we took a look on the following address: http://www.memory-key.com/Parents/international_curriculum.htm.

² To give appropriate information we analyzed information about French educational system from different Internet sites. To make a brief over the French system of education you may search information at the following address http://en.wikipedia.org/wiki/Secondary_education_in_France.

³ A résumé on the Romanian education at: http://en.wikipedia.org/wiki/Secondary_education_in_Romania.

⁴ Relevant information you can find at the following Internet address: www.edu.ro, English version.

⁵ Source: Russell, S. J. (1997). The role of curriculum in teacher development. In S. N. Friel and G. W. Bright (Eds.) *Reflecting on Our Work: NSF Teacher Enhancement K-6*. Lanham, MD: University Press of America.

⁶ Within the SEDEC Project, during Lagos (Portugal) Science teachers` international seminar (February, 2007)– as a dissemination and evaluation step at the Project – we developed this exercise with the Portuguese teachers and this activity confirmed our affirmation mentioned above.

⁷ The debate was organized in France on 30 April 2007, during an in-service training course, with 15 teachers of every level in primary school. The entire meeting was lasting 1 hour and 15 minutes, being organized in two main parts: at first time, teachers wrote their answers at debate questions on the paper; at the second part, every question was debated among teachers, according to their answers on the sheets. Question after question, teachers spoke on their ideas and the debate could extend. The questions were shown with a video-projector on a screen and the teachers write their answers on a sheet, we took about 5 min by question, i.e. 35 minutes. A teacher took notes on the debate and during the meeting the French language was used. Etienne Bolmont (our French colleague in the SEDEC) was coordinating this activity and afterwards has translated the teachers` answers in English. At the end he made a synthesis of their answers. All the discussions were registered on the iPod.

⁸ The Romanian debate was organized on 18 June 2007, as an appendix to a research project that I was involved. This research project was developed in Constanta (one large university city), 20 Science teachers being announced about this meeting two weeks in advance. At the debate participated 14 teachers of every level in secondary education (5th - 8th forms). Constanta is a county as well, so at the meeting were presented Science teachers from all over the county, not only from the Constanta city – which is the capital of the county. The debate lasted 1 hour and 30 minutes and a lot of other points of view were developed during discussions, most of the issues being related to the didactic day by day activity during Science lessons. The procedure was similar with that one developed in France, when teachers were answering questions in two phases of the meeting – first written answers and then debating upon the answers. Another teacher (there is about the inspector for Romanian Language that helped us to organize this meeting) took notes on the debate. Spoken language was Romanian and then I have translated the teachers` answers in English. Teachers` debate was registered on the audio tape then a transcript has been done.

⁹ Active learning may best be described as a style of instruction that departs from the traditional lecture based method of dispensing information and the note taking / term paper writing / periodic examination based method of receiving and regurgitating information. (...) According to this source, the main characteristics of active learning consist in the fact that: active learning techniques stimulate critical thinking; active learning is better tailored to fit changing patterns of concentration; active learning addresses the diversity of learning styles; active learning reinforces important democratic skills. (Source: http://faculty.saintleo.edu/SLU101/information/active_learning.htm)

- ¹⁰ L. Capita and M. Cerkez, *The Development of Communication Competency for Students from Compulsory Education*. Institute for Educational Sciences, Bucharest, Romania. (in Romanian) (2004).
- ¹¹ L. Dumbraveanu, *Romanian School System*, in W. Horner et al. (eds.), *The Educations Systems of Europe*, Springer, Leipzig, Germany (2006).
- ¹² S.J. Russell, *The role of curriculum in teacher development*, in S. N. Friel and G. W. Bright (eds.) *Reflecting on Our Work: NSF Teacher Enhancement K-6*. Lantham, MD: University Press of America (1997).
- ¹³ <http://www.lelycee.org/academics/curriculum.en.php>
- ¹⁴ http://www.memory-key.com/Parents/international_curriculum.htm
- ¹⁵ http://faculty.saintleo.edu/SLU101/information/active_learning.htm
- ¹⁶ http://en.wikipedia.org/wiki/Secondary_education_in_Romania
- ¹⁷ http://en.wikipedia.org/wiki/Secondary_education_in_France
- ¹⁸ www.edu.ro

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