Science Education in the Mediterranean region: Editorial

Alice Delserieys

Aix-Marseille Université
ENS Lyon
ADEF EA 4671
13248 Marseille, France
alice.delserieys@univ-amu.fr

Science education has been the subject of a particular attention for several years on an international level. Successive reports have been published during the last twenty years and tend to have convergent conclusions and recommendations (Boilevin, 2013) for the promotion of a science education addressed to all students (and not only future scientists) from preschool to university. In particular, the latest report from the European Commission (European Commission, 2015) insist on various aspects: (1) the importance of a continuum of science education from preschool to active engaged citizenship, (2) the importance of a focus on competences that go beyond one science subject and link several subjects together, (3) the importance of quality in teacher education, and (4) on the role played by research in education to enhance the efficiency of renovated science teaching and learning. This volume is set in such a context and presents a series of research in science education all coming from different countries across the Mediterranean region. These researches have been originally presented at the fourth workshop of the SIEST Mediterranean network that took place in Rabat in October 2014. Created in 2008, this network brings together academics from Algeria, France, Greece, Lebanon, Morocco, and Tunisia. It aims at promoting the development of a dynamic of research in science education across the Mediterranean region[1]. This network can be considered as an example of a dynamic of scientific collaborations

1 http://espe.univ-amu.fr/fr/content/seminaire-siest-mediterranee

between countries in the north and the south of the Mediterranean Sea that has an old history (Valdalbero, Schunz & Liberatore, 2015). It allows in particular the engagement of young researchers in the community of science didactic[2] through the interactions and dialogue between researchers. It also enhances exchanges in order to bring new ideas and knowledge for the questions raised by the evolution of science education following the different international recommendations: which competences to develop in science for the future generation of citizens, which teaching approaches to promote in a word where many new technologies are available for teachers to use, what is conveyed by teaching resources such as school textbooks in the logic of science curricula, etc. The articles selected for this volume are far from giving an exhaustive overview of science education in the Mediterranean region. However, they give some trends of current science education research conducted in the Mediterranean countries concerned, and the international issues that are addressed.

The first researches presented can be considered part of a long tradition of science education interested in the teaching of specific concepts and the learning difficulties associated to these concepts: chemical reactions for the text of Aouad & Andreucci, waves for Mazouze & Lounis, and energy for Givry & Pantidos. The scientific literature has identified many difficulties, conceptions, or representations that can be recurrently encountered amongst students for these science concepts (Duit, 2009; Johsua & Dupin, 2003). However, the context in which these concepts are taught is specific to each country and influence the way students will understand the concept. This is brought forward in the articles of Aouad & Andreucci, of Mazouze & Lounis, or Mouheli. If the concepts of science are broadly the same, Jorde & Dillon (2012) stress the fact that "the delivery of the science curriculum happens in many different ways, thus producing very different learning outcomes" (p. 2) from one country to another. Different approaches are therefore proposed in the researches presented in this volume in order to allow students to go beyond the difficulties usually identified, such as the use of computer technologies, or the use of problem solving. The way concepts are represented in physics teaching also seems to take an important place with a deep reflection on semiotic resources (Lemke, 1998), also inherited from mathematics education (Duval, 1993).

Aouad & Andreucci are thereby interested in chemical education in Lebanon, and in particular in the teaching of chemical reactions, which is a fundamental concept of chemistry. The authors are proposing to help students reaching an understanding of chemical reaction and overtaking some recurrent difficulties using Microprocessor-Based Laboratory (MBL). In an experimental approach, they compare the progression of a group of students using MBL with two other groups going through other teaching modalities (presentation of lab-work, traditional lab-work). The positive effect of the use of MBL

2 The word « didactic » is to be understood in the French tradition and includes the study of teaching and learning of a subject.

with Lebanese students is shown by a better use of scientific language related to chemical reaction and a better understanding of the idea of heat energy. This research therefore extend previous observations in other countries concerning the use of MBL. This time, it focuses on the Lebanon context, with relatively young students (12-13 years old) and a macroscopic approach of the concept of chemical reaction.

In a second article, it is the concept of wave that is studied for students at the end of secondary education in the context of Algeria. Mazouze & Lounis are interested in this concept of physics that is already well documented in the literature concerning students' difficulties (Maurines, 1999). Such a reflection in science education in Algeria is more recent. In order to get a better picture of students' difficulties to get an understanding of waves, the authors cross teachers' opinion on the matter with students' answers to a questionnaire. The research is also taking its grounds in the introduction of teaching approaches such as problem solving in physics recently introduced in the Algerian curriculum. A difficulty to understand interference phenomena is identified amongst students, agreeing with what teachers perceive of their students' difficulties. However, the Algerian teachers who took part in the study insist on the difficulty student encounter in the transfer of mathematical equations to graphical representations. This does not seem to be recognise as a difficulty by the students tested. The authors highlight the obstacle of mathematical formalism for students to address abstract concepts of physics such as waves. In consequence, they encourage the use of a variety of representations to explain wave phenomena, joining the reflection on semiotic resources introduced in the following article of this volume.

Emerging from a collaboration between Greek and French researchers, the third text is concerned with teaching the concept of energy. Givry & Pantidos give a brief overview of the complexity to teach this concept. They attribute partly this complexity to the disconnected approach used in teaching when energy is a unified concept from the point of view of physics. Using a semiotic approach, they analyse how a physics teacher in Greece presents the concept of energy. For that, they use the written documents and text books used by the teacher as well as classroom videos for verbal and non-verbal expression. They identify ambiguities emerging from the use of various semiotic registers. In particular, they see a confusion between the notion of energy transfer from one system to another and the notion of energy transformation within a system. The article concludes with a proposition to represent, on a same diagram, the physical systems considered, the forms of energy in each system, the transformations of energy within a system and the transfer of energy from one system to another. Their proposition situates the results of research in education as a potential to give specific solutions that teachers can seize in order to overtake difficulties identified amongst students in the construction of the concept of transfer and transformation of energy.

The next articles of this volume allow me to identify a second broad trend in

science education in the Mediterranean. It links with contemporary issues of science teaching where science learning has a broader purpose than the learning of a subject content. Using the words of Reiss (2015), science education should "enable each learner to lead a life that is personally flourishing and to help others to do so too" (p. 22). In this second part of the volume, the researches presented are considering issues related to such a view of the goal of science education, and in particular student motivation, the meaning of science teaching, and also the idea of *education with...*[3] (Lange & Victor, 2006). These questions, introduced in the prescriptions of many countries, give a role to science education that contributes to the development of citizen that can act in a complex and changing world (European Commission, 2015).

El Moussaouy, Errahmani and Abderbi thus propose an analysis of secondary school physics textbook in Morocco. They seek to identify how these textbook propose learning situations attached to a context meaningful for students. For physics teaching at secondary level, the authors refer to contexts in which science knowledge are elaborated in relation to contemporary development of research, or history of science, as well as everyday life. Doing so, they meet a common concern with many other countries (Boilevin, 2013): a concern that seeks to provide to students a meaning to the knowledge learned in physics classes. Such questions are strongly linked to the question of student motivation. There analyses is based on a semiotic approach according to Duval (1993) in order to identify the forms of representations of physics concepts in Moroccan textbooks. They highlight that there is a strong dominance of mathematical characters in the textbooks analysed and little contextualised situations. Such observation joins the findings of Mazouze and Lounis also presented in this volume done in the context of Algeria for teaching waves in physics. They conclude with the need for changes in science teaching practices in Morocco, despite the fact that curricula are already recommending the use of contextualisation in teaching science.

In a next article, Mouheli presents work from the international project Biohead-Citizen, highlighting a dynamic of south Mediterranean universities within Euro-Mediterranean partnerships. It concerns health education in Tunisia and analyzes Tunisian biology textbooks. The author underline the proximity of some of his results with those obtained in other Mediterranean countries (and in particular, France and Morocco). This reinforce the relevance of Mediterranean collaborations in terms of science education. The research work presented by Mouheli is based on a didactical approach of biology teaching and biological concepts. The author analyzes the textbooks and in particular the variety of images appearing. In his article, it is interesting to

3 In French, the expression "education à..." refers to objects that are not attached to a specific subject or curricula but rather cover a broad area of knowledge due to the traversal nature of the object of study. It is the case of health education, environmental education or sustainable development awareness.

note the importance given to biology education in its role to allow prevention and promotion of health that goes beyond a strict approach only related to risks, bans or taboos. If the approach chosen in that article is attached to the school subject "biology and geology", the author strongly stresses the importance of interdisciplinary approaches to tackle complex health questions with students. They require a deep understanding of concepts from several subjects as well as other skills or attitudes of responsibility and autonomy. It is a good example of questions related to the trend of "education with...".

Finally, the last text of Coupaud, Castera, Larini and Delserieys proposes a methodological reflexion. It discusses the potential offered by exploratory statistics to process data from questionnaires in science education research. The authors observe in particular some necessary conditions in order to design a questionnaire that allows an analysis with exploratory statistics in order to increase the results reliability. This methodological reflexion is based on a research concerning the representations of teachers from different school subjects about inquiry based science education introduced in secondary school French curricula of biology, physics – chemistry and technology.

To conclude, I would like to thank the editor of "***Review of Science, Mathematics and ICT Education***", Konstantinos Ravanis, to allow this special volume about science education in the Mediterranean. I also would like to thank all the authors and reviewers who contributed to this volume, as well as the colleagues and institutions that bring dynamic to the SIEST Mediterranean network for science education.

References

Boilevin, J.-M. (2013). *Rénovation de l'enseignement des sciences physiques et formation des enseignants. Regards didactiques*. Bruxelles: De Boeck.

Duit, R. (2009). Bibliography - STCSE: Students' and teachers' conceptions and science education. Retrieved from http://archiv.ipn.uni-kiel.de/stcse/.

Duval, R. (1993). Registre de représentation sémiotique et fonctionnement cognitif de la pensé. *Annale de didactique et de sciences cognitives de l'IREM de Strasbourg, 5*, 37-65.

European Commission (2015). *Science Education for Responsible Citizenship*. Luxembourg: European Commission. Retrieved from http://ec.europa.eu/research/swafs/pdf/pub_science_education/KI-NA-26-893-EN-N.pdf.

Johsua, S., & Dupin, J.-J. (2003). *Introduction à la didactique des sciences et des mathématiques*. Paris: PUF.

Jorde, D., & Dillon, J. (2012). *Science education research and practice in Europe: retrospective and prospective*. Rotterdam: Sense Publ.

Lange, J.-M., & Victor, P. (2006). Didactique curriculaire et « éducation à... la santé, l'environnement et au développement durable » : quelles questions, quels repères ? *Didaskalia*, *28*, 85–100.

Lemke, J. L. (1998). Multiplying meaning: Visual and verbal semiotics in scientific text. In J. R. Martin & R. Veel (Éds.), *Reading Science* (pp. 87-113). London: Routledge.

Maurines, L. (1999). Students and the Wave Geometrical Model of the Wave Propagation in a Three Dimensional Medium. In M. Bandiera, S. Caravita, E. Torracca, & M. Vicentini (Eds.), *Research in Science Education in Europe* (pp. 103–112). Netherlands: Springer.

Reiss, M. J. (2015). Learning for a better world: Futures in Science Education. In D. Corrigan, C. Buntting, J. Dillon, A. Jones, & R. Gunstone (Eds), *The future in Learning Science: What's in it for the learner?* (pp. 19–34). Cham: Springer International Publishing.

Valdalbero, D. R. di, Schunz, S., & Liberatore, A. (2015). La recherche : fer-de-lance d'une coopération euro-méditerranéenne renouvelée. *Confluences Méditerranée*, *93*(2), 155–168.