



A Curricular Approach to Develop Autonomies from the Mathematics and Scientific Education

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Abstract

The purpose of this work is to highlight how the current Spanish education system supports the development of both scientific and mathematic competences. We understand these competences as the set of skills and capabilities needed to use mathematics or science when the situation requires. For that purpose, we have carried out a curricular didactic analysis of the current regulations in Andalusia. This analysis intends to reveal how the new educational systems emphasize the development of the formative character of teaching-learning processes, which has been overshadowed by the functional and the instrumental characters in Science and Mathematics Education. The findings of the research show that the objectives set out in the law are aimed at developing in students a number of attributes such as personal autonomy, creativity, tolerance, empathy, critical spirit, etc. From our point of view, all of these attributes contribute to developing the students' formative character. Besides, the analysis shows that course contents are not presented as an end in itself, but as a means for students to acquire these attributes and be whole human beings. Finally, it can be inferred from the analysis that both the methodological guidance and the evaluation criteria highlight the need to educate citizens to be capable of adapting to the environment and positively transforming it. Ultimately, promoting teaching-learning processes where scientific and mathematic competences are developed, educating students to be intellectually, socially and morally autonomous.

Keywords: *Science and Mathematics Education, autonomies, formative dimension, mathematical and scientific competences.*

1. Introduction

Mathematics and Science have three distinct dimensions: instrumental, formative and functional, while being purely interdisciplinary subjects that are related to almost every field of reality, not only to science or technology, but with other disciplines often not associated with them such as Social Science, Music, games, poetry or politics.

In this research we have focused in that formative character, usually forgotten in teaching and learning processes, but needed in order to offer an all together education to the citizens of the 21st century, in our humble opinion.

Traditionally, from an educational perspective, it is considered that certain mathematical and scientific activities promote the development and the acquisition of cognitive skills, hence the necessity from a formative point of view. Practically the entire Mathematics and Science syllabus appreciate this teaching and its formative dimension. However, the formative character in Mathematics and Science is not limited to cognitive aspects, since they are related to norms and values and to the emotional realm, as well [11].

Most studies (Ex. [2], [3], [5], [12]) show that research centred around the analysis and evaluation of teaching and learning processes have paid little to none attention to the formative potentiality of the proposals, considering that they highlight specific aspects that do not question this potentiality. We notice, indeed, how recommendations and didactical proposals from relevant institutions in the field of Education are disregarded. Due to all these reasons, we find it indispensable to analyse whether those institutions aim to promote the formative dimension of the Mathematical and Scientific Education or not, developing high-quality educational processes and giving response to the needs of the society.

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2. The formative character of Mathematical and Scientific Education in the curricular guidelines. Attributes involved in autonomy development.

Education is a social process and, consequently, a Mathematical and Scientific education should consider this social aspect.

This may seem an obvious statement, but the social, human and essentially interpersonal nature of education is usually disregarded, prioritising the acquisition of mathematical techniques and willing to achieve an “efficient” Mathematical and Scientific Education. [1]

However, the current Spanish educational system supports a high-quality and an efficient teaching, which consider the social nature of education.

As a matter of fact, one of the main objectives of the Curricular Framework is developing the Mathematical and Scientific competence, understood as the set of capacities and skills needed in situations in which mathematical, scientific and technological knowledge is needed. ([6], [7], [8], [9]).

To provide evidence of this statement, we have carried out a didactical curricular analysis of the current legislation in Andalusia, [10]. With this analysis we want to show how the new Educational Systems highlight the development of the formative dimension of the teaching and learning processes in Mathematics and Science, usually forgotten in order to develop the functional and the instructional character.

Results of the study show that the objectives set out in legislation are aimed to develop several attributes in the students, such as autonomy, creativity, tolerance, empathy, critical spirit, etc., which allow to develop the formative character in the individual, in our opinion.

“To understand the importance of the usefulness of the knowledge of Biology and Geology to meet the human needs and to take part in the decision-making processes concerning local and global problems” (p.133)

“To know and to value the interactions between Science and Technology and society and the environment, in order to work towards a sustainable future.” (p.150)

“To value Mathematics as a constituent part of the Andalusian culture, both from an historical approach and from the current perspective, as well. To apply the mathematical competences acquired to discuss and analyse several social phenomena, such as cultural diversity, the care of all living beings and the environment, health, consumption, the recognition that both sexes contribute to our society and to the mathematical knowledge gathered through humanity and its contribution to economic growth based on sustainable models and social usefulness or pacific coexistence.” (p.204)

Besides, the analysis shows that course contents are not presented as an end in itself, but as a means for students to acquire these attributes and be whole human beings.

“Search, classify and interpret the scientific information, and use that information to build an own opinion, to express adequately and to argue about environment and health.” (p.135)

“To develop minor researches in which the scientific method is applied and ICTs are used.” (p.151)

“To use information and communication technologies in the usual way during the learning process, searching, analysing and classifying the relevant information on the Internet, producing own documents, showcasing, arguing and sharing them in appropriate environments in order to facilitate interaction.” (p. 207)

Finally, the analysis shows how methodological guidelines and the evaluation criteria also highlight the necessity of educating citizens to permanently adapt to the environment and eventually transform it positively.

“Working in cooperative and well-balanced groups, which represent the classroom diversity and which promote students’ participation, is highly important in order to acquire the key competences. Producing and showcasing theoretical and experimental works develop the linguistic competence, both in the work-group while selecting and sharing the individual work and while laying out the results of the research to the rest of students.

Furthermore, respect for the group members’ ideas is encouraged, hence what matters is the cooperation to achieve the best outcome together. The assessment students make of both their individual work and the work undertaken by the rest of the group members, implies a



greater involvement in their learning and teaching process, enabling them to learn from the strategies used by their classmates.” (p. 150)

“The historical, social and cultural dimension of Mathematics must be planned in a careful and coordinate way, in order to provide understanding to the notions through the historical perspective and to contrast social contexts from other times and cultures with the current reality, approaching historical figures and their contributions from a different perspective, recognising the personal circumstances of women in Mathematics and the obstacles they had to overcome to get access to education and science.” (p.205)

To sum up, promoting teaching and learning processes where Scientific and Mathematical competences are developed, educating students to be intellectually, socially and morally autonomous.

3. Conclusions

In this paper we show how Spanish institutions promote the development of Scientific and Mathematical competences, where their formative dimension plays a significant role, leading to high-quality educational processes and meeting the demands of the 21st century society.

Ultimately, the necessity to promote an individual's autonomy from three aspects: intellectual, moral and social. That is, considering authors such as López-Melero, Mancila & Sole [7], we believe that mathematical and scientific areas should boost: the capacity to think for oneself and generate information to solve real life problems (intellectual autonomy); the ability to make decisions when faced with real life problems with a social conscience (moral autonomy); and the capacity to make decisions applying social abilities and skills (social autonomy).

The following step would be to analyse whether the guidelines established by institutions are being considered in the different teaching and learning processes. Due to the fact that educative processes are often based on teaching and learning units or curricular proposals that appear on textbooks, this research group is currently conducting a more detailed study in which a variety of Spanish textbooks are being analysed.

Acknowledgement

This study is part of the project “Criterios e instrumentos de evaluación de unidades de enseñanza y aprendizaje” [Criteria and instruments for evaluation of teaching and learning units] (PPIT.UMA.B1.2017/16) funded by the University of Málaga in the assembly of 2017-2018.

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