Evaluation of socio-cultural factors in the learning of human evolution in the urban context of Rome

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Abstract
The teaching of evolutionary theory represents one of the most exciting challenges for science teachers. The learning of the main principles of biological evolution and, more particularly, the origin of human species could be influenced by the socio-cultural environment. Our preliminary investigation among final year students of high schools located in both the centre and outlying area of the city of Rome, Italy suggests that socio-cultural factors (family background, urban context and others) may affect the achievement of comprehending the scientific basis of human evolution during the high school formative process.

KEYWORDS: evolution, high-school students, human diversity, social environment

Introduction
Teaching the theory of evolution represents one of the most exciting challenges for science teachers in the light of its interdisciplinary implications, driving diverse fields towards a common theoretical background (e.g. Longa et al. 2013). In fact, the scientific community recognises the educational potential of evolution in the formation of the next generation of students relying on a strong epistemological basis (Smith 2010; Bajd 2012; Rosengren

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et al. 2012). Obstacles limiting the learning of the main principles of biological evolution and, more specifically, the origin of human species may be of various nature: teachers holding misconceptions driven by sociological biases or not convinced of the importance of evolution as a crucial biological topic (Pievani 2012; Yates & Marek 2013 and related citations therein); textbooks and media often provide oversimplified concepts causing misconceptions (Wescott & Cunningham 2005); cognitive biases preventing students' full understanding of the epistemological foundations of evolutionary theory (Sthulman & Calabi 2013). Close to these aspects it is also worth mentioning the relationships between socio-cultural environment and education and their influence on the school performance of young students. In a previous paper, we suggested the relevance of the family's cultural context in the education of children (Rufo et al. 2013). Other recent studies pointed out the influence of the familial, cultural background on the development of the interests of students (e.g. see Daouli et al. 2010; Pereira 2010). However, in addition to the "vertical" transmission of culture operating within the family, it should be also taken into account the influence of social context in shaping the personality of children.

In this brief note, we present a preliminary evaluation of the effects of socio-cultural factors on the learning degree of the concept of biological evolution and the diversity of human species in a sample of final year students of high schools located in both the centre and outlying areas of the city of Rome, Italy.

Data and methods

The sample consists of 1,108 students from 5th class (51.1% males, 48.9% females) in nine high schools, five scientific (SCI) and four humanistic (HUM) located in the centre and in outlying areas of Rome (Figure 1). Students from the centre were 239 HUM (schools nos. 4 and 5; Figure 1) and 95 SCI (n. 6). Those from the outlying areas were 177 HUM (nos. 1 and 3) and 597 SCI (nos. 2, 7, 8, and 9). The study was conducted via an *ad hoc* questionnaire structured as described in Rufo et al. (2013).

Administration of the anonymous questionnaire was carried out by the teachers to assure mass participation and to ensure that its compilation took place in the conditions to which the students were accustomed. The research project itself and the aims and the modes of its realisation were presented and discussed in detail with the headmasters, the teachers, and the students of the institutions that had volunteered to participate. This was made in order to obtain verbal informed consent by each of them on the basis of their degree of involvement.

Statistical analyses were performed using SAS software, version 9.2, SAS Institute Inc, Cary, NC. We adopted a quantitative indicator (overall score) able to summarise the correctness of the answers provided by the students to the various questions (see Rufo et al. 2013 for more details). We divided the overall score variable in two classes ($P \leq 75$: from the first to the third quartile of the distribution; $P > 75$: the fourth quartile) in order to investigate the relationships between students' scores and the students' socio-cultural context.

Figure 1: Map of Rome showing the schools involved in the study (1: Liceo Ginnasio Aristofane, 2: Liceo Scientifico Nomentano, 3: Liceo Ginnasio Seneca, 4: Liceo Ginnasio Terenzio Mamiani, 5: Liceo Ginnasio Ennio Quirino Visconti, 6: Liceo Scientifico Plinio Seniore, 7: Liceo Scientifico Benedetto Croce, 8: Liceo Scientifico Aristotele, 9: Liceo Scientifico Labriola).

Results and discussion

The development of strong skills in the evolutionary theory during the education process is fundamental in order to provide students the most powerful tools to understand the variety of topics related to the biological sciences. However, the influence of socio-cultural factors can be crucial in shaping the degree of student learning. In fact, the identification of conditions of diversity among cohorts of students has been widely used in educational research as a tool to investigate the effects of the social environment on student achievement (e.g. see Coleman 1968; Jencks et al. 1972; Mortimore et al. 1988; Schneider et al. 2007). This study analyses the variability of the scores among high school students both living in central and suburban areas of the city of Rome. As a first result, we did not observe statistically significant differences between genders regarding the distribution of the overall scores. Therefore, we conducted the analyses considering the whole sample.

Two main factors influencing the ability of the children to deal with the concepts of evolution and human biological and cultural diversity emerge. Firstly, the educational level of the parents is reconfirmed as representing a highly significant variable (χ^2=22.761, Df=3, p<0.0001), as previously ascertained in Rufo et al. (2013). The highest percentage of students who achieved a score greater than 75 (32.5%) was observed among those with both parents with a university degree. Conversely, the lowest (10.3%) was found among students with non-graduate parents. Secondly, the urban context turns out to be a significant variable (χ^2=7.623, Df=1, p=0.005; see Figure 2A). Students who attended schools in the city center produced the following results: 66.8% with a score up to 75 and 33.2% with a score in the fourth quartile (P>75). Students attending schools in suburban areas of the city had lower scores: 78.2% with a score up to 75 and 21.8% greater than 75. Interestingly, 72.1% of students from the city center schools had at least one parent graduate, whereas 50.8% of suburban students were children of parents whose highest educational level was high school diploma (Figure 2B).

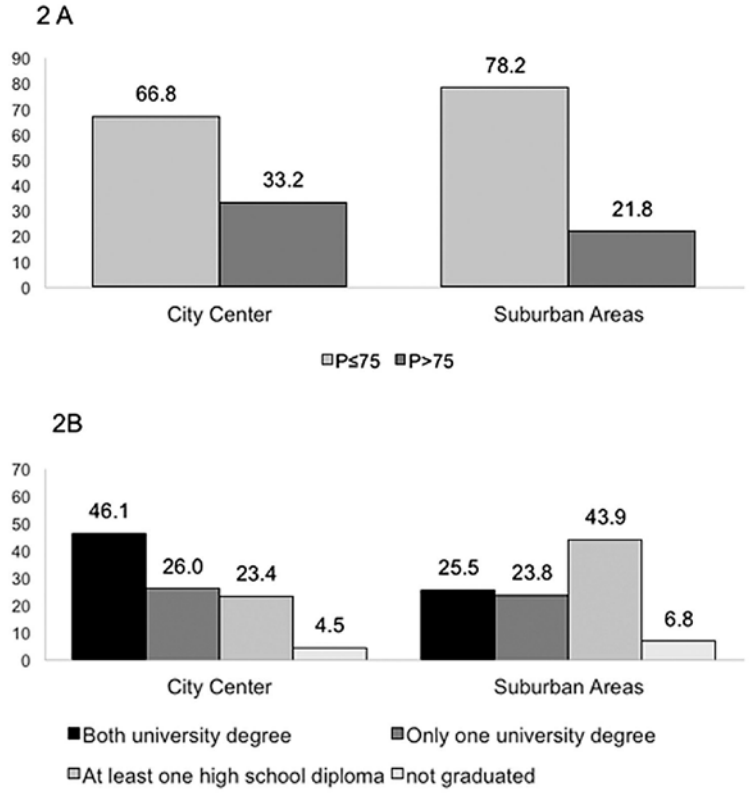

Figure 2: Distribution of the students' scores (A) and distribution of parental education (B) with respect to the urban context

These preliminary results suggest that the social environment, other than the family, also plays a role in the achievement of comprehending the scientific basis of human evolution during the high school formative process. This is in line with our previous analysis (see Rufo et al. 2013) and with evidence from other investigations regarding the learning of other school subjects developed in both Italy (Checchi et al. 2006) and other socio-cultural contexts (Daouli et al. 2010; Pereira 2010; Graham & Provost 2012). Future work should consider the extension of the sample to the whole Italian territory and the administration of a questionnaire aimed at understanding the complex social dynamics involved in the learning processes.

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Povzetek

Poučevanje evolucijske teorije predstavlja enega izmed najbolj zanimivih izzivov za učitelje naravoslovja. Na učenje glavnih načel biološke evolucije in še zlasti izvora človeške vrste, bi lahko vplivalo tudi socialno-kulturno okolje. Naša predhodna raziskava med dijaki zadnjih letnikov srednjih šol, ki se nahajajo tako v središču kot predmestju Rima v Italiji, kažejo, da lahko socialno-kulturni dejavniki (družinsko ozadje, urbani kontekst in drugi) vplivajo na dojemanje znanstvene podlage človeškega razvoja med formativnim procesom v srednji šoli.

KLJUČNE BESEDE: razvoj, dijaki, človeška raznolikost, socialno okolje

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