International Journal of Environmental & Science Education
Vol. 7, No. 2, April 2012, 217-232

Greek Secondary School Students' Views About Biology

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Received 5 September 2011; Accepted 22 February 2012

This paper aims to give a picture of Greek students' views about biology and some of the factors that affect them. A questionnaire measuring students' intrinsic motivation to learn biology, individual interest in biology and perceived difficulty of biology, along with information about students' gender, level, parents' occupation and educational level was administered to 368 Greek students. Results revealed that Greek secondary school students have almost neutral overall views about biology: they are slightly positive about biology's usefulness in their lives, perceive it as rather easy, but 26.4% finds no interest in it. Gender does not seem to affect students' overall views about biology, neither their scores in any of the subscales - biology in Greece is as popular among boys as among girls. Younger and older students differ only in their perceived difficulty of biology, with the older students considering it more difficult than the younger ones. Parents' educational level (both mothers and fathers are taken into account) is important in affecting only students' intrinsic motivation, since the more educated a parent is the higher intrinsic motivation a student has towards biology. Parents' occupation does not affect students' views about biology.

Keywords: biology, secondary school students' views, interest, perceived difficulty, intrinsic motivation

Introduction – Literature Review and Key Objective of the Study

Today's educational policy is heading towards a more active role of students in the whole educational system (Ball, 2008). According to Whitty & Wisby (2007) schools would benefit by giving a greater emphasis to students' voice. That means giving them a more active role in their education and schooling along with teachers becoming more attentive to what students say about their learning experiences during their school life (Hargreaves, 2004). Focusing academic research on students' conceptions, attitudes, interests and goals in science would help teachers a lot in their new role.

Developing positive attitudes towards science is one of the most important goals of every country's national curriculum (Koballa & Crawley, 1985; Laforgia, 1988). Today, there is a vast amount of literature concerning attitudes towards science in general (Barmby et al., 2008; Md Zain et al., 2010; Osborne et al, 2003), an adequate amount concerning attitudes towards physics and chemistry (Angell et al., 2004; Cheung, 2009; Salta & Tzougraki, 2004) and a smaller number of studies concerning students' attitudes towards biology (Prokop et al., 2007a, 2007b; Spall

ISSN 1306-3065

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et al., 2004). It is more than obvious that students' attitudes towards science constitute a major chapter in the scientific field of science education. However, such studies need to be followed by others that would focus on: a) the influence of curriculum on students' attitudes (Osborne et al., 2003, p.25), and b) students' experiences and interests about science, both very useful in designing and reshaping science curricula that would engender a more positive attitude in both boys and girls to school science and could influence learning and academic performance (Baram-Tsabari & Yarden, 2007; Hidi & Harackiewicz, 2000). But Zacharia and Barton (2004, p. 199) suggested that "attitudes are affected by students' interest levels in science, the curriculum and the learning climate", therefore literature focused on factors affecting students' interest in biology (Delpech, 2002; Ebenezer & Zoller, 1993; Trumper, 2006; Baram-Tsabari & Yarden, 2007) as also on other factors that affect their views or internal constructions about biology (Spall, et al. 2004; Martins et al., 2000) is also of great importance. Among the most important factors that shape students' views about school science, and consequently about biology, are considered: a) biology's perceived difficulty (Crawley & Black, 1992; Havard, 1996; Hendley et al., 1996; Salta & Tzougraki, 2004), which according to Lyons (2006) is mostly due to the way science is taught (transmissive pedagogy, teacher-centered) along with the overloaded science curriculum, and the irrelevant and boring science content, b) its relevance to everyday life (Ramsden, 1998) or as mentioned in OECD (2007, p. 146) "students' intrinsic motivation" or intrinsic motivation to learn biology, c) the necessity of relatively good biological knowledge background for a future career in a field such as medicine or pharmacy (Simpson & Oliver, 1990) or as mentioned in OECD (2007, p. 148-149) "students' future oriented motivation to learn biology" and last but not least d) students' interest as "personal orientation, predisposition or relatively stable tendency to engage with a particular domain, referred to as individual interest" (Ainley & Ainley, 2011, p.53, which has been proven to have a strong impact on achievement (Harackiewicz et al., 2002; Randler & Bogner, 2007). Moreover, factors such as student gender (Keeves & Kotte, 1992; Jones et al., 2000; Ormerod, 1981; Zeidan, 2010), student's grade-level (Spall et al., 2004; Greenfield, 1997), the familial status - parents' socio-economic background (Papanastasiou & Zembyla, 2004; Kyridis, 1996, 1997; Kyridis & Drosos, 2001; Kyridis et al., 2011) – have been proven to affect students' interest in science or children's school achievement. Especially for the latter, since 1974, numerous researchers in Greece showed off that socioeconomic background of the family affects school achievement and specially the success of entering higher education. Students who belong in vulnerable social groups or they live in a poor cultural environment (low educational level of the parents, low family income, rural area of residence) are eligible to lower school achievement.

In Greece, secondary schooling consists of 6 years (3 years in High School – grades 7^{th} to 9^{th} - which are compulsory and 3 years in Lykeion – grades 10^{th} to 12^{th} - which are optional) and the subject of biology (till the school-year 2010-11) was obligatory in grades 7th, 9th and 11th, and optional in grade 12th, depending on the direction of studies chosen by a student. In 2011 there have been announced changes in the school syllabus and school curriculum, which have not yet been established. Till today, in Greece there is a spiral curriculum according to which students of 7th grade are supposed to learn about the scientific method, the organization of life, the cell, food and nutrition, systems of transportation and excretion, movement, reproduction, respiration and how organisms respond to stimuli, all with an emphasis to the human systems. In grade 9th students are supposed to learn about the scientific method, the organization of life, the cell, ecology, metabolism, diseases, genetics, biotechnology, evolution. In grade 11th students are supposed to learn the chemistry of life, the cell, metabolism and genetics, whereas in grade 12th students are supposed to learn: a. microbes and diseases, ecology, evolution, b. DNA, genetics, biotechnology (there are two different biology subjects and students may or may not attend them

depending on their direction of studies· those attending the direction "Science" are obliged to attend both). Unfortunately if the announced by the government changes in the educational system are going to be established only a very few number of students will have the opportunity to attend biology in grades 11th and 12th.

Although there is a large-scale survey about Greek school students' science- related interests (Christidou, 2006) – as part of the Relevance of Science Education (ROSE) project by Schreiner & Sjøberg (2004) - and their dependence of the Greek curriculum (Smyrnaiou & Dimopoulos, 2005), Greek students' views about biology apart from the other science subjects, as also the factors that affect them has never been studied.

This paper aims at filling this gap and answering to the following research questions, having in mind that - borrowing a phrase from Schreiner & Sjøberg (2004, p.77) - it is not our intention to measure "theoretically predefined constructs in a strict psychometric sense":

- Do Greek secondary school students possess positive views about biology?
- Are there differences between boys' and girls' views about biology?
- Are there differences between lower grade-level students' and higher grade-level students' views about biology?
- Does the parents' socio-economic background affect students' views about biology?
- How do factors such as students' interest, future oriented motivation to learn biology, intrinsic motivation and the perceived difficulty of biology interact to shape students' views about biology?

Research Sample and Method

The sample of our study was a convenience sample consisting of 368 Greek students from 6 state-funded schools in Athens that we could easily access: 249 from the 8th grade (2^{nd} year in the Greek secondary education system) and 119 from the 12^{th} grade (3^{rd} year in the Greek high school). Students of the 8^{th} grade are about 12 years old and students of the 12^{th} grade are about 17 years old. Data were collected in January of the school years 2008-2009 and 2009-2010 in the form of a written questionnaire. Students of the 8^{th} grade had attended biology courses for only one year (during the 7^{th} grade, that is the previous school year), but students of the 12^{th} grade had attended biology courses during three past years (grades 7^{th}, 9^{th}, 11^{th}) and during the year that this research was carried out as they had chosen a direction of studies that required biology as one of the examined subjects at the end of the year. We chose students from the above mentioned grades in order to compare students with the lowest and highest level of biology education.

For the purpose of our study we conducted an initial pool of 44 5point Likert-type statements to which Greek secondary school students had to state whether they *strongly agreed, agreed, neither agreed nor disagreed, disagreed or strongly disagreed*. These statements intended to measure Greek secondary school students':

- intrinsic motivation to learn biology
- interest in biology
- perceived difficulty of biology and students' views about the way biology is taught.

These three axes constituted the three subscales of the instrument. The construction of these statements was based on the relevant aforementioned literature and the researchers' experience. Ten in-service biology teachers with masters' degrees in biology education helped us in checking the face validity of the instrument. They were asked to check the clarity and appropri-

ateness of these statements, as also whether they were undoubtedly fitted in one of the above mentioned subscales of the instrument. Following their advice we excluded those items that were not clearly understandable or were inaccurate and we finally resulted in 24 items. These items (presented in Table 1) were based on the literature as following:

- Spall et al. 2004: items 1-3, 5, 6, 13, 15, 18, 20-24
- OECD 2007: item: 4, 12, 14, 16, 17, 19
- Pintrich & Schunk, 1996: items 7-11,

  and were assigned to one of the three subscales of the research instrument and which from now on will be named accordingly:
- Intrinsic motivation to learn biology (IM) = 11 items,
- Interest in biology (IN) = 8 items,
- Perceived difficulty and views about biology teaching (DI) = 5 items.

Scoring was accomplished by assigning a score of 5 to "strongly agree" and a score of 1 to "strongly disagree" for the positively phrased items, that would therefore result in one of the following: high intrinsic motivation for biology, biology is interesting and biology is easy. Negatively worded items (2, 4, 5, 15, 19, 21, 22, 23) were scored in an opposite direction with "strongly agree" receiving a score of 1 and "strongly disagree" receiving a score of 5.

In order to check the internal consistency of the questionnaire we followed the steps described by Halkia (1995). The questionnaire was initially delivered to 28 students, trying to get a heterogeneous sample (not all boys, not all of the same educational level). The estimated Cronbach's alpha (α=.89) revealed a high degree of reliability of the test scores (Nunnally & Bernstein, 1994), and the internal consistency of the subscales was also estimated by the use of Cronbach's alpha (α_{IM}=.72, α_{IN}=.86, α_{DI}=.75) and considered acceptable (George & Mallery, 2003). As a result we proceeded to the administration of the questionnaire.

The 24 items of the questionnaire were accompanied by other questions giving us information about:

- the participants' gender,
- the participants' school level (gymnasium – lower secondary level - or high school – upper secondary level) and therefore their age, as students in each level were of about the same age (14-15 years old for gymnasium students and 17-18 years old for high school students),
- their parents' occupation and
- their parents' (mother's and father's) educational level.

For the last two questions we used the grouping mentioned by Kyridis (1997), so a parent could be: an employee, a farmer, a scientist, a public servant, a blue-collar worker, a merchant or a service provider and his/her educational level could be: illiterate, primary education, lower secondary education, upper secondary education, technical education, higher education, postgraduate education. All data were analyzed by the authors, making use of the statistical program SPSS v16.1 (SPSS Inc.). A two-tailed alpha level of .05 was used for all statistical tests. A p-value of less than .05 was considered to be statistically significant. The hypothesis of normal distribution was not satisfied for each of the instrument's subscales ($D_{IM(295)}$=0.26, p<.001, $D_{IN(295)}$=0.20, p<.001, $D_{DI(295)}$=0.22, p<.001)

Results

In order to assess the predefined scales we performed a confirmatory factor analysis through a principal components method and varimax rotation for 3 factors, with eigenvalues greater than 1.0. These factors altogether explained 46.1% of variance. All items had factor loadings greater than 0.30 in at least one factor and were distributed to each factor by the way they were was expected to do, except for:

- 3 items from factor (subscale) IM that although they had loadings greater than 0.3 in this subscale their loadings were slightly higher in subscale IN, and
- one item from factor IM that had the same loading in DI.

The reliability of the questionnaire scores (Cronbach's alpha, α=0.89) proved to be almost excellent (George & Mallery, 2003), whether the reliability analysis performed for each of the sub-scales, as these were predefined, revealed an acceptable internal consistency for each sub-scale (Table 1). This led us to accept the subscales as they were originally constructed.

Greek secondary school students' views about biology seem to be neutral to marginally positive positive (M=3.27(±0.77)). Differences between students' answers in each of the subscales were tested using Friedman's test. Although the medians were the same Mdn_{IM}=Mdn_{IM}=Mdn_{IM}=3.00, there were significant differences between students' scores in each of the subscales ($\chi_{(2)}^2$= 39.823, p<.001). Post-hoc analysis via Wilcoxon Signed Ranks Test revealed differences between students' answers in the subscale measuring their interest in biology and the other subscales (IM and DI) ($z_{IN\text{-}IM=}$ -6.438, p<.001, $z_{DI\text{-}IN=}$ -5.147, p<.001). As it is presented in Figure 1, the subscale that measures students' interest (IN) is the one in which more students carry a negative view about biology: 26.4% of Greek secondary school students are not interested in biology, in contrast to 32.8% of them are interested. Table 2 presents Greek secondary school students' scores in each subscale.

Eighth and twelfth grade's students' views for biology, as also boys' and girls' views are presented in Table 3. Mann_Whitney U-test revealed that boys and girls show no statistical significant differences in any of the instrument's subscales (p>.05), whereas grade seems to be important in affecting only their perceived difficulty of biology (DI) (χ_1^2=14.94, p<.001). Students of the 12th grade find biology more difficult than students of the 8th grade. As students proceed in the Greek upper secondary school they perceive biology as more difficult – whereas about half of the students of the 8th grade perceive biology as easy (49.34%), it is only about one third of older students (32.43%) that do the same (Figure 2).

Students' intrinsic motivation to learn biology is significantly (p<.001) correlated to students' interest to biology and students' perceived difficulty of biology (r_s=.54 and r_s=.45 respectively). Significantly correlated (p<.001) is also students' interest to biology to the perceived difficulty of biology (r_s=.49). Therefore, students' perceived difficulty of biology, their intrinsic motivation to learn biology and their interest to biology are all positively correlated. Family seems to be an important factor affecting Greek secondary school students' views about biology. When all other variables (parents' occupation and educational level -separately for mothers and fathers) are separately tested using the Kruskal-Wallis test for possible effects to *IN, IM* and *DI* we found that it is only the parents' educational level that plays an important role and only in affecting statistically significant students' intrinsic motivation (*IM*) (Figures 3 and 4), but not in affecting *IN or DI* , whereas mother's educational level has a greater effect than father's (χ_{father}^2=14.03, df=6, p<.05, χ_{mother}^2=18.45, df=6, p<.01). Parents' occupation does not influence statistically significant students' views about biology.

Table1. *The internal consistency estimates of each subscale and the items in each one*

ITEMS*	**Cronbach's alpha**
Intrinsic motivation to learn biology (IM)	
1. I find necessary the existence of the subject of biology in the Curriculum	.77
2. Biology courses should be optional	
3. Biology courses must have a greater presence in the curriculum	
4. I read biology only when I am going to be tested	
5. I believe that biology will be useless for my everyday life	
6. Biology makes our lives better	
7. Attending biology courses made me understand the function of living beings	
8. Attending biology courses made me understand better the surrounding world	
9. Biology made me get a better view of the world	
10. Biology gets me informed on contemporary scientific discoveries	
11. I discuss with my friends things I learn in biology courses	
Individual Interest in biology (IN)	
12. I am very interested in the scientific field of biology	.83
13. I am very interested in the subject of biology	
14. I am interested in a future professional enrollment in the field of biosciences	
15. Biology is a boring subject	
16. I am interested in working in the field of biology in the future	
17. I often read books with a biological content	
18. I would like to attend biology classes in all school grades	
19. If biology was not one of the subjects that we have to be tested in order to have access to University I would not be interested at all	
Perceived difficulty & views about teaching (DI)	
20. I am satisfied by the way that biology is taught	.69
21. The way that the subject of biology is taught made me dislike it	
22. I find it difficult to understand many of the biological concepts	
23. The biology textbook does not help me understand the biological concepts	
24. I am glad that there is some extra information in the biology textbook	

**The items have been numbered that way in order to facilitate the reader, but were randomly assigned in the research instrument.*

Table 2. *Greek secondary school students' scores in each subscale of the instrument*

	N	M	SD	Min	Max
INTRINSIC MOTIVATION (IM)	295	3.41	.736	1	5
INTEREST (IN)	295	3.08	.981	1	5
DIFFICULTY (DI)	295	3.33	.880	1	5

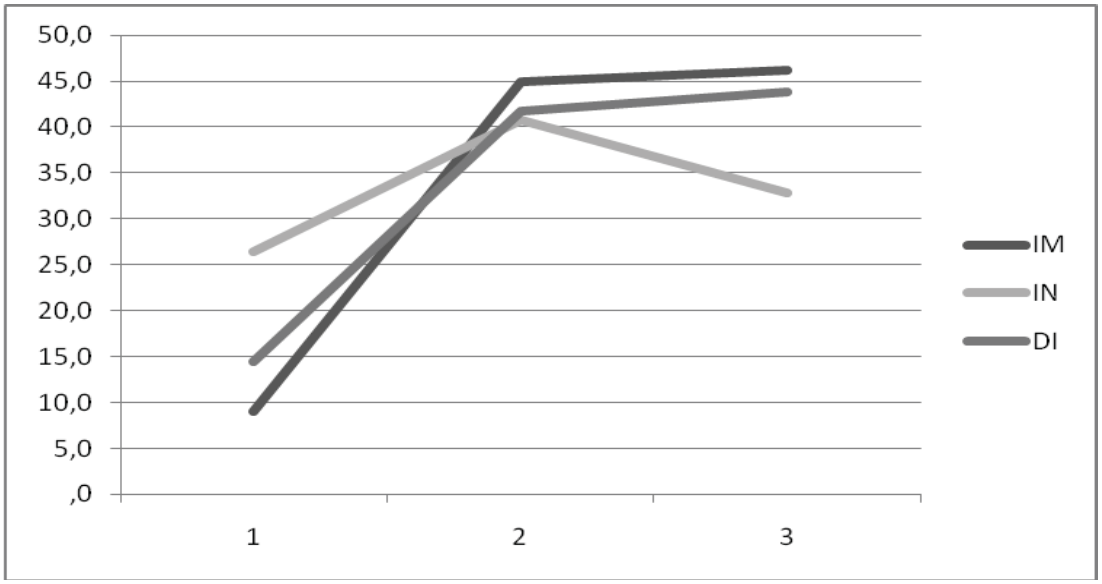

Figure 1. *Greek secondary school students' distribution* according to whether they are motivated towards biology (IM), whether they are interested in it (IN) and whether they find it difficult (DI).*
*For a better presentation students' answers have been processed so that the 5-point scale was converted to a 3-point scale.

Table 3. *Students' scores in each of the subscales according to grade and gender*

		Mean (SD)		
		Intrinsic motivation (IM) *1=not motiv., 5=very motiv.*	**Interest (IN)** *1=not inter., 5=very inter.*	**Perceived difficulty (DI)** *1=very dif., 5=very easy*
Gender	boys	3.37(0.75)	3.07(0.92)	3.42(0.85)
	girls	3.44(0.71)	3.10(0.98)	3.32(0.92)
Grade	8th	3.41(0.73)	3.09(0.91)	3.50(0.85)
	12th	3.39(0.72)	3.08(1.03)	3.08(0.90)

Discussion

Gender does not seem to affect students' overall views about biology a finding that is in accordance with relevant findings about Iranian secondary school students (Soltani & Nasr, 2010). Although in a research carried out by Simonneaux et al. (2005) more girls than boys considered science as difficult and Keeves & Kotte (1992) and Jones et al. (2000) and Prokop et al. (2007b) and Uşak et al. (2009) suggest that biology is more popular among girls than boys, this is not in accordance to our findings. Also, our results show no differences among boys' and girls' intrinsic motivation to learn biology, whereas OECD (2007, p. 148) results revealed a higher intrinsic

motivation among boys to learn science. It seems that this may be true for science in general but biology in Greece is as popular among boys as among girls.

Although Spall et al. (2004) suggest that the older the students the less positive they become towards biology, this was not the truth in our sample from Greece, since no statistical significant differences were found between younger and older Greek secondary school students in their overall opinion about biology. However, we recorded differences among younger and older students only in their perceived difficulty of biology. The older the students are the more difficult they perceive biology. This may be attributed to the fact that biology is taught as an independent and isolated subject in the secondary school according to the Greek national curriculum, which is so overloaded that becomes unrealistic and in most of the times cannot be accomplished, resulting finally even in the loss of teaching of the unifying theory of biology – evolution - which is presented in the last part of the curriculum (Prinou, 2008). It may also be attributed to the fact that upper secondary school students in our sample would be examined in biology by the end of the school year and these exams are critical as they determine whether a student may continue

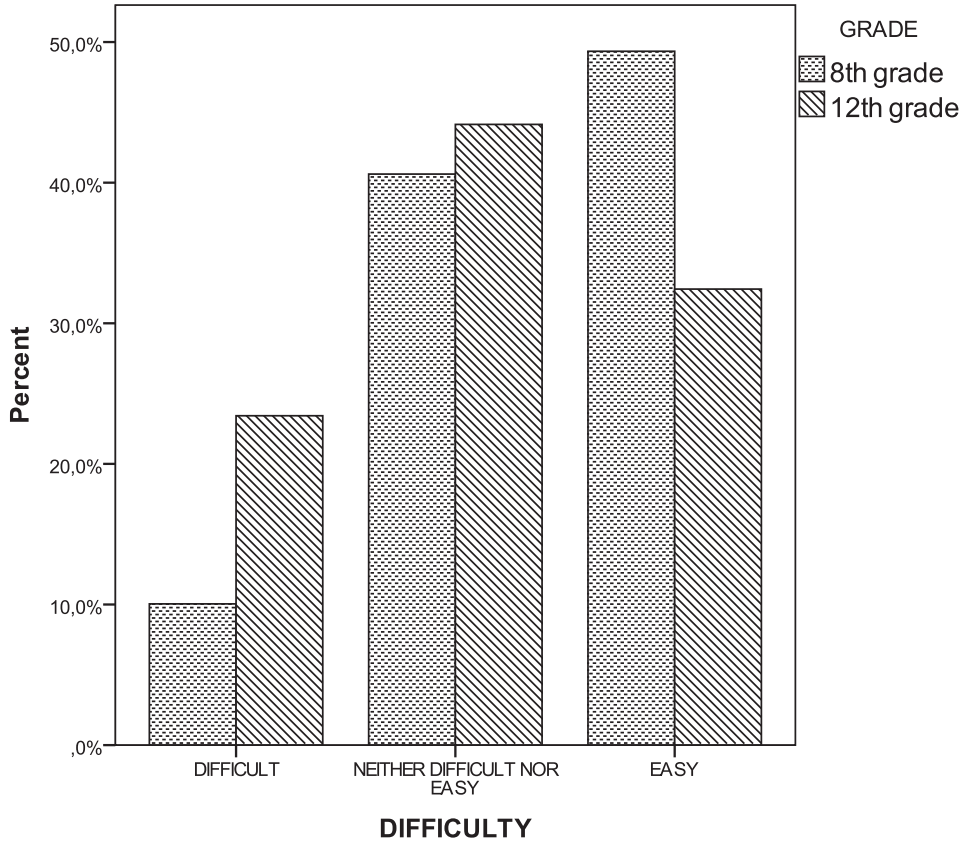

Figure 2. *Students' distribution* according to grade and their perceived difficulty of biology.*
*For a better presentation students' answers have been processed so that the 5-point scale was converted to a 3-point scale.

his/her studies to higher education. It may also be attributed to the fact that the Greek secondary school is based on knowledge repetition and not on enhancing students' interest and critical thinking, therefore students as they proceed through secondary school's grades they have to learn by heart more and more biology facts in a teacher-centered pedagogy**.** Although it is common truth that teacher-centered pedagogy should be abandoned in favor to a more student-centered one, this has not yet happened in Greece and becomes even more intense in bigger grades where teachers are feeling more pressed by the curriculum and by the students' anxiety of the approaching exams. The connection between the pedagogy or the way biology is taught and its perceived difficulty has been stated by Lyons (2006) and may be an explanation to our findings.

Parents' educational level plays an important role in affecting students' intrinsic motivation, with mother's educational level playing an even more important role than father's. Students whose parents are illiterate show low intrinsic motivation, whereas students whose parents have a university degree (graduate or postgraduate) are higher motivated towards biology. The above findings are impressive and may attributed to the fact that parents in Greece are very much involved in the school process (Kyridis, 1995) and their involvement in the school process together we the social class they belong to are considered important in affecting students' attitudes towards school (Trusty, 1996; Steinberg et al., 1992). Therefore, parents with a higher educational level based on their own experiences may have affected positively their children towards biology. And as mothers in Greece are those who are more committed to their children's educational process it is them who affect them the most (Kyridis, 1997).

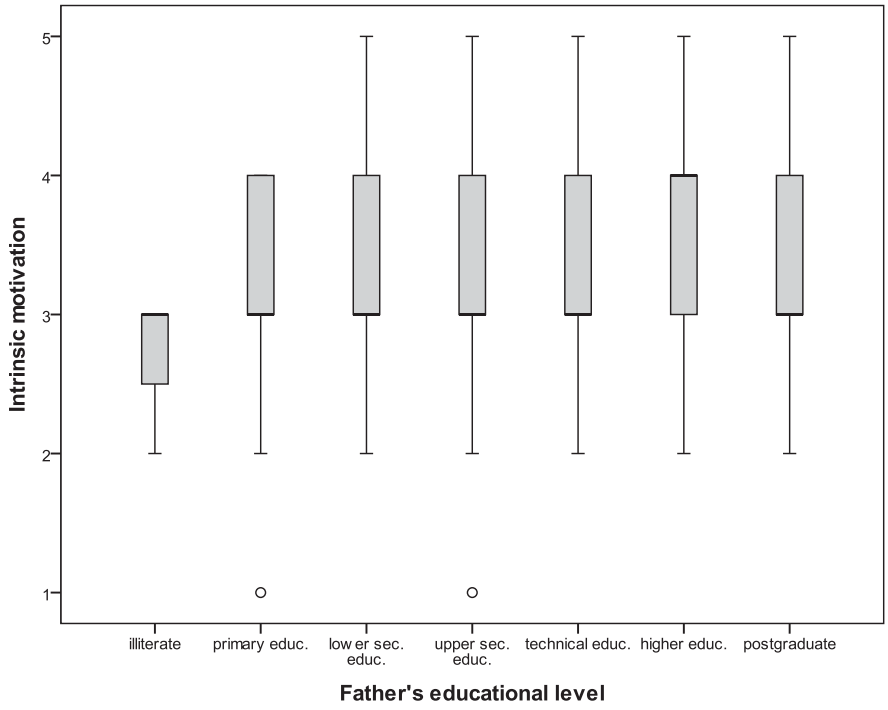

Figure 3. *Boxplots of students' instrumental motivation according to their father's educational level*

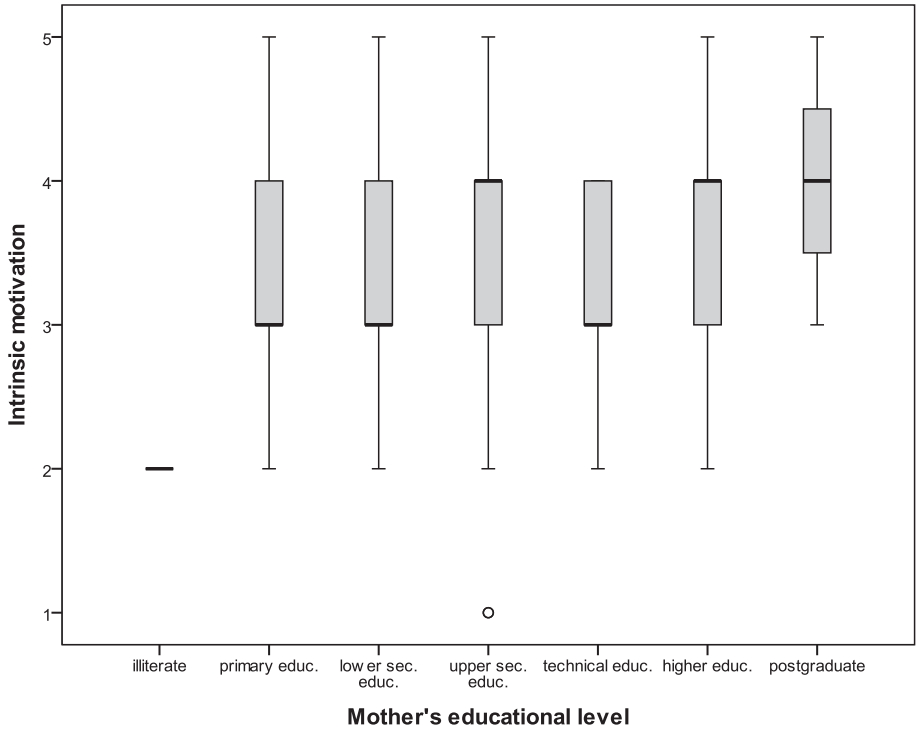

Figure 4. *Boxplots of students' instrumental motivation according to their mother's educational level*

The positive correlations among students' interest and students' intrinsic motivation support the suggestion of Deci & Ryan (1985: 34) that "the emotion of interest plays an important directive role in IM behavior in that people naturally approach activities that interest them". "As intrinsic motivation results in high-quality learning and creativity, it is especially important to detail the factors and forces that engender (it)" (Ryan & Deci, 2000: 55). Greek secondary school students have almost neutral views about biology. Although they are slightly positive about biology's usefulness in their lives and do not perceive it as difficult, they are neither interested nor disinterested in it. Although we are living in the century of biology, the Greek educational system seems to disregard this and does not focus on enhancing students' interest in biology, since till recently biology was taught as a one hour per week subject and only in some of the six grades. The last (2011) educational reform that has roused all biology teachers in every educational level (see for example Alachiotis, 2011, Chintiroglou, 2011) and has not yet been completed, sets biology in an even worse position - maybe due to the pressures by some of the educational craft unions - as only a very small percentage of the Greek students will have obtained by the end of their studies the necessary biology knowledge for their everyday lives. In general, the greatest problem that biology has to deal with in the Greek secondary school is that more than a quarter of students (26.4%) find no interest in it, when in other countries of the world students' disinterest in biology is restricted to a far smaller percentage, such as in Portugal (only 6%) (Martins et al., 2000). This may be due to its fragmentary presence in the Greek curriculum (biology appears in the 7th, then in the 8th and then in the 11th and 12th grade, with a lot of its content being needlessly repeated) (Mavrikaki, 2008). It also may be attributed to the spiral formation of the Greek biology curricu-

lum in which same topics are studied again and again in order to get a more in-depth understanding, but may lead to a dislike and disinterest on behalf of the students' views, a suggestion also supported by other researchers (Spall et all, 2004), or it may be due to the overloaded biology curriculum as with the rest of science subjects (Lynch, 2000). Nonetheless, as Hidi & Renninger (2006) suggest interest can develop following a four-phase model of interest development and the teacher is one of the factors that can positively affect this development. This could be done a) in the phase of triggered situational interest (phase 1), e.g. by creating learning environments that include group work, b) by maintaining the situational interest (phase 2), for example by letting the students to get personally involved in activities such as project-based learning, c) by emerging individual interest (phase 3), which can be done by providing environments that challenge and give opportunity and d) in the fourth phase by well-developing individual interest, such as giving the opportunities to reengage with particular classes of content over time.

The findings of this paper should be taken under consideration when designing new secondary school curricula in order to enhance students' interest towards biology "in a way that a) respects social and cultural diversity and gender equity; b) promotes personal and social relevance; c) empowers the learner for democratic participation and citizenship" (Christidou, 2011). It would also be interesting to investigate the views that Greek secondary school students have towards other science subjects as well, therefore to examine if students are indifferent towards school in general or only towards biology. Although we found no statistical significant differences in Greek students' views about biology according to their parents' occupation, another occupations' grouping (relevant to biology or not) may be needed in order to find out whether some students' views are formed by their parents' profession or by school alone.

References

Ainley, M., & Ainley, J. (2011). A Cultural Perspective on the Structure of Student Interest in Science. *International Journal of Science Education*, *33*(1), 51-71.

Alachiotis, S. (2011, May 22). The "abortion" of Biology. *The tribune.* Retrieved 20/0802011 from http://www.tovima.gr/opinions/article/?aid=402094 (in Greek).

Angell, C., Guttersrud, O., Henriksen, E.K., & Isnes, A. (2004). Physics: Frightful, But Fun - Pupils' and Teachers' Views of Physics and Physics Teaching. *Science Education, 88*, 683–706.

Ball, S.J. (2008). *The education debate*. Bristol, UK: The Policy Press.

Baram-Tsabari, A., & Yarden, A. (2007). Interest in Biology: A developmental shift characterized using self-generated questions. *The American Biology Teacher, 69*(9), 532-540.

Barmby, P., Kind, P. M., & Jones, K. (2008). Examining Changing Attitudes in Secondary School Science. *International Journal of Science Education, 30*(8), 1075-1093.

Cheung, D. (2009). Students' attitudes toward chemistry lessons: the interaction effect between grade level and gender. *Research in Science Education, 39*(1), 75-91.

Chintiroglou, Ch. (2011, August 29). In the road of Darwin. *The News.* Retrieved 30/08/2011 from http://www.tanea.gr/gnomes/?aid=4652678 (in Greek).

Christidou, V. (2006). Greek Students' Science-related Interests and Experiences: Gender differences and correlations. *International Journal of Science Education, 28*(10), 1181-1199.

Christidou, V. (2011). Interest, attitudes and images related to science: Combining students' voices with the voices of school Science, teachers, and popular science. *International Journal of Environmental & Science Education, 6*(2), 141-159.

Crawley, E.F., & Black, B.C. (1992). Causal modeling of secondary science students' intentions to enroll in physics. *Journal of Research in Science Teaching, 29*(6), 585-599.

Deci, E.L., & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York: Plenum Press.

Delpech, R. (2002). Why are school students bored with science? *Journal of Biological Education, 36*(4), 156-157.

Ebenezer, J.V., & Zoller, U. (1993). Grade 10 students' perceptions of and attitudes toward science teaching and school science. *Journal of Research in Science Teaching, 30*(2), 175-186.

George, G., & Mallery, P. (2003). *SPSS for windows step by step: A simple guide and reference, 11.0 update*. Boston, MA: Allyn & Bacon.

Greenfield, T.A. (1997). Gender- and Grade-Level Differences in Science Interest and Participation. *Science Education, 81*(3), 259-276.

Halkia, K. (1995). *Greek Teachers'attitudes towards Physics*. Athens: National & Kapodistrian University of Athens. (in Greek). Retrieved 30/8/2011 from http://thesis.ekt.gr/thesisBookReader/id/5342#page/1/mode/2up

Harackiewicz, J.M., Barron, K.E., Tauer, J.M., & Elliot, A.J. (2002). Predicting success in college: A longitudinal study of achievement goals and ability measures as predictors of interest and performance from freshman year through graduation. *Journal of Educational Psychology, 94,* 562-575.

Hargreaves, D. (2004). *Personalizing learning—2: student voice and assessment for learning* London: Specialist Schools Trust.

Havard, N. (1996). Student attitudes to studying A-level sciences. *Public Understanding of Science, 5,* 321-330.

Hendley, D., Stables, S., & Stables, A. (1996). Pupils' subject preferences at key stage 3 in South Wales. *Educational Studies, 22*(2), 177-187.

Hidi, S., & Harackiewicz, J.M. (2000). Motivating the, academically unmotivated: a critical issue for the 21st century. *Review of Educational Research, 70*(2), 151-179.

Hidi, S., & Renninger, K. A. (2006). The Four-Phase Model of Interest Development. *Educational Psychologist, 41*(2), 111-127.

Jones, M. G., Howe, A., & Rua, M. J. (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education, 84*(2), 180-192.

Keeves J., & Kotte, D. (1992). Disparities between the sexes in science education: 1970-84. In J. Keeves (Ed.), *The IEA study of science III* (pp. 141-164). New York: Pergamon,

Koballa, T.R., & Crawley, F.E. (1985). The influence of attitude on science teaching and learning. *School Science and mathematics, 85*(3), 222-232.

Kyridis, A. (1995). Panhellenic General Exams – Strategic planning for a position near the sun. *Contemporary Education*, *78,* 34-37. (in greek).

Kyridis, A. (1996). *Educational Inequality.* Thessaloniki: Kyriakides Bros. (in greek).

Kyridis, A. (1997). *Inequalities in Greek education and access to the University (1955-1985).*Athens: Gutenberg (in Greek).

Kyridis, A., & Drossos, E. (2001). Thirty years of inequality in the Greek educational system. *Contemporary Education*, *118,* 68-79.

Kyridis, A., Tsakiridou, H., Zagkos, Ch., Koutouzis, M. & Tziamtzi, Ch. (2011). Educational inequalities and school dropout in Greece. A regional issue. *International Journal of Education, 3*(2), 1-15.Laforgia, J. (1988). The affective domain related to science education and its evaluation. *Science Education, 72*(4), 407-421.

Lynch, S. J. (2000). *Equity and Science Education Reform.* Mahwah, NJ: Lawrence Erlbaum Associates.

Lyons, T. (2006). Different Countries, Same Science Classes: Students' experiences of school science in their own words. *International Journal of Science Education, 28*(6), 591-613.

Martins, I.P. Dias, C.C., Silva, I.P. (2000). Biology in the secondary school: from the students' views to the school curriculum. Paper presented in the International Symposium: "BioEd 2000" - The Challenge of the next Century, 15-18 May, 2000, organized by the International Union of Biological Sciences Commission for Biological Education (IUBS-CBE), in collaboration with the Muséum National d'Histoire Naturelle (MNHN), Paris, France, the Laboratoire de Didactique et Epistémologie des Sciences (LDES) of the University of Geneva, Switzerland, and UNESCO. Retrieved 20/5/2010 from http://www.iubs.org/cbe/cbe_paper_index.html.

Mavrikaki, E. (2008). The biology subject in secondary education – Examples and comparisons from nine countries. In A. Trilianos & I. Karaminas (eds), *Proceedings of the 6th Pan-Hellenic Conference of the Greek Pedagogical Society "Greek Pedagogy & Educational Research"* (pp. 1165-1171). Athens: Atrapos (in Greek).

Md Zain, A.N., Samsudin, M.A., Rohandi, R., Jusoh, A. (2010). Using the Rasch Model to Measure Students' Attitudes toward Science in "Low Performing" Secondary Schools in Malaysia. *International Education Studies, 3*(2), 56-63.

Nunnally, J.C., & Bernstein, I.H. (1994). *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

Ormerod, M.B. (1981). Factors differentially affecting the science subject preferences, choices and attitudes of girls and boys. In A. Kelly (ed.), *The Missing Half: Girls and Science Education* (pp. 100-112). Manchester, UK: Manchester University Press.

OECD (Organisation for Economic Co-operation and Development). (2007). *PISA 2006: Science competencies for tomorrow's world* (Vol. 1: Analysis). Paris: Author.

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: a review of the literature and its implications. *International Journal of Science Education, 25*(9), 1049-1079.

Papanastasiou, E. C., & Zembylas, M. (2004). Differential effects of science attitudes and science achievement in Australia, Cyprus and the USA. *International Journal of Science Education, 26*(3), 259-280.

Prinou, L. (2008). *The "image" of the Theory of Evolution in the Greek school.* Unpublished Ph.D. thesis. Athens: Faculty of Primary Education, University of Athens (in Greek).

Prokop, P., Prokop, M., & Tunicliffe, S.D. (2007a). Is biology boring? Student attitudes toward biology. *Journal of Biological Education, 42*(1), 36-39.

Prokop, P., Tuncer, G., Chudá, J. (2007b). Slovakian students' attitude toward biology. *Eurasia Journal of Mathematics, Science & Technology Education*, *3*(4), 287-295.

Ramsden, J.M. (1998). Mission impossible?: Can anything be done about attitudes to science? *International Journal of Science Education, 20*(2), 125-137.

Randler, C. & F.X. Bogner (2007). Pupils' interest before, during and after a curriculum dealing with ecological topics and its relationship with achievement. *Educational Research and Evaluation, 13,* 463-478.

Ryan, R. M., & Deci, E.L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology, 25*, 54-67.

Salta, K., & Tzougraki, C. (2004). Attitudes toward chemistry among 11th grade students in high schools in Greece. *Science Education, 88*(4), 535-547.

Schreiner, C., & Sjøberg, S. (2004). Sowing the seeds of ROSE. Background, Rationale, Questionnaire Development and Data Collection for ROSE (The Relevance of Science Education) - a comparative study of students' views of science and science education. *Acta Didactica, 4*, Retrieved 5/8/2011 from http://www.uv.uio.no/ils/english/research/projects/rose/actadidactica.pdf

Simonneaux. L., Albe, V., Ducamp, Ch., & Simonneaux, J. (2005). Do High-School students' perceptions of science change when assigned directly by researchers? *Eurasia Journal of Mathematics, Science and Technology Education, 1*(1), 21-40.

Simpson, R., & Oliver, J. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. *Science Education, 74*(1), 1-18.

Smyrnaiou, Z., & Dimopoulos, K. (2005). The relevance of the science curriculum with Greek students' interests. In D. Koliopoulos & A. Vavouraki (Eds.)*, Science Education: the challenges of the 21st century* (pp. 3–13). Athens, Greece: Association for Science Education (in Greek).

Soltani, A., & Nasr, A. (2010). Attitude towards Biology and its Effects on Student's Achievement. Paper presented at the 2nd Paris International Conference on Education, Economy and Society – 2010. Retrieved 30/8/2011 from http://ui-ir.academia.edu/AsgharSoltani/Papers/179877/Attitude_towards_Biology_and_its_Effects_on_Students_Achievement

Spall, K., Stanisstreet, M., Dickson, D., & Boyes, E. (2004). Development of school students' constructions of biology and physics. *International Journal of Science Education, 26*(7), 787-803.

Steinberg, L., Dornbusch, S.M., & Brown, B.B. (1992). Ethnic differences in adolescent achievement. An ecological perspective. *The American Psychologist, 47*(6), 723-729.

Trumper, R. (2006). Factors affecting Junior High School Students' Interest in Biology. *Science Education International, 17*(1), 31-48.

Trusty, J. (1996). Relationship of Parent Involvement in Teens' Career Development to Teens' Attitudes, Perceptions, and Behavior. *Journal of Research and Development in Education, 30*, 317-323.

Uşak, M., Prokop, P., Özden, M., Özel, M., Bilen, K., Erdoğan, M. (2009). Turkish university students' attitudes toward biology: the effects of gender and enrolment in biology classes. *Journal of Baltic Science Education*, *8*(2), 88 – 96.

Whitty, G., & Wisby, E. (2007). Whose voice? An exploration of the current policy interest in pupil involvement in school decision-making. *International Studies in Sociology of Education, 17*(3), 303-319.

Zacharia, Z., & Barton, A.C. (2004). Urban Middle-School Students' Attitudes toward a Defined Science. *Science Education, 88*(2), 197-222.

Zeidan A. (2010). The relationship between grade11 Palestinian attitudes toward biology and their perceptions of the biology learning environment. *International Journal of Science and Mathematics Education, 8*(5), 783-800.

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Yunanlı Ortaöğretim Öğrencilerinin Biyoloji Hakkında Görüşleri

Bu çalışma biyoloji ve bunları etkileyen bazı faktörleri hakkında Yunanlı öğrencilerin görüşlerinin bir resmini vermeyi amaçlamaktadır. Cinsiyet, sınıf düzeyi, aile mesleği, eğitim seviyesi öğrencilerin biyoloji, bireysel ilgi ve öğrenciler biyoloji zorlukları hakkında bilgilerini değerlendirmek için içsel motivasyon ölçen bir anket 368 Yunanlı öğrencisine uygulanmıştır. Öğrencilerin sadece büyük çoğunluğu biyoloji pozitif düşünceye sahipken, % 26,4'ü biyoloji konusunda ilgisizdirler. Sonuçlar Yunan ortaöğretim öğrencilerinin biyoloji hakkında neredeyse nötr genel görüşlere sahip olduğunu ortaya koymuştur. Cinsiyet öğrencileri etkileyecek düzeyde olmasında rağmen, biyoloji kızlar arasında erkekler arasında da popüler bir yerdir. Yaşa göre öğrencilerin biyoloji dersini zor yada kolay oalrak algılamaları farklıdır, yaşları büyük olan öğrenciler biyoloji dersini yaşları küçük olana göre daha zor olarak algılamaktadır. Ebeveynlerin meslekleri öğrencilerin biyoloji hakkındaki görüşlerini etkilememektedir.

Anahtar kelimeler: biyoloji, ortaöğretim öğrencilerinin görüşleri, ilgi, algılanmış zorluk, içsel motivasyon