Albanian first-year university students' knowledge and acceptance of evolution

Fundime Miri [1] ![iD], Ani Bajrami [2*] ![iD], Evangelia Mavrikaki [3] ![iD]

[1] Department of Biology, Faculty of Natural Sciences, University of Tirana, Tirana, ALBANIA
[2] Museum of Natural Sciences "Sabiha Kasimati", Faculty of Natural Sciences, University of Tirana, Tirana, ALBANIA
[3] Department of Pedagogy and Primary Education, School of Education, National and Kapodistrian University of Athens, Athens, GREECE

Abstract

Evolutionary theory provides the foundation for modern biology with evolution as a core concept and unifying principle. This research aimed to examine evolutionary knowledge and acceptance among first-year university students. The participants considered for analysis consisted of 87 students enrolled in the first-year bachelor's in biology and biotechnology at the University of Tirana, Albania. The respondents' average age was 18.95 ± 0.78 years, with a pronounced dominance of females (90.2%). The study used the standardized research instrument "evolution education questionnaire on acceptance and knowledge" to measure knowledge and acceptance about evolution in an international context. We employed descriptive statistics to analyze the collected data. The findings of research revealed that over half of the respondents, 61%, fall into the '*very low knowledge*' category on evolution and none fall in the '*high knowledge*' category. Only 60.9% accept evolution. The need for a revision of the evolutionary concepts and topics in the curricula, from primary school, is recommended coupled with the incorporation of philosophical dialogue into teaching practice.

Keywords: evolution, knowledge, acceptance, students, Albania

INTRODUCTION

Evolutionary principles are present in peoples' everyday lives and extend to other disciplines such as medicine (Bergstrom & Feldgarden, 2007; Hendry et al., 2011; Ruhli & Henneberg, 2013), agriculture (Thrall et al., 2010), environment management and policy (Johnson, 2022; Lankau et al., 2011) and in human socio-cultural context, mind, and behavior (Bajrami et al., 2019; Boyd & Richerson, 1985; Cavalli-Sforza & Feldman, 1981; Cosmides & Tooby, 1987; Heinrich, 2016; Inglehart, 2018; Mesoudi, 2011).

It is important for the students to not only understand evolution but to also accept it as the best scientific explanation for the unity and diversity of life on earth (Misheva et al., 2023). A large body of research has examined knowledge and acceptance of the evolution of university and high school students (Barnes et al., 2022; Gefaell et al., 2020; Kuschmierz et al., 2021; Nadelson & Hardy, 2015; Oliviera et al., 2022), among teachers (Beniermann et al., 2023; Tekkaya et al., 2012; Venetis & Mavrikaki, 2017), the general public (Kuschmierz et al., 2020; Miller et al., 2022; Zhu et al., 2020), and recently in popular media and online spaces (Ferguson et al., 2022; Park & Seo, 2023).

Several factors influence or contribute to knowledge and acceptance of evolution, including among others:

(1) religious identity and religiosity (Beniermann et al., 2023; Mantelas & Mavrikaki, 2020; Oliviera et al., 2022),

(2) trust in science and scientists (Nadelson & Hardy, 2015),

(3) political orientation and having a role model discuss the compatibility between religion and evolution (Ferguson & Jensen, 2021; Miller et al., 2022), and

(4) scientific literacy (Dunk et al., 2017; Gefaell et al., 2020; Weisberg et al., 2018).

Contribution to the literature

- This study contributes to the understanding and implications of the knowledge and acceptance of evolution among Albanian first-year university students.
- This study identifies a significant gap in evolutionary knowledge and acceptance among first-year biology students in Albania, as evidenced by the finding that 61% of students exhibit very low knowledge of evolution and none display high knowledge.
- This study provisions data, regarding evolutionary knowledge and acceptance, which are useful for comparisons between Albania and other countries or between Albanian populations.

Additionally, how key concepts and topics on evolution are described in the school curricula of all grades, by not using an interdisciplinary approach, contributes to a lack of knowledge and understanding of evolution (Hanisch & Eirdosh, 2020; Nehm et al., 2009). Furthermore, major aspects regarding evolution are not considered as important in some European countries' school syllabi/curricula. In the first large study regarding the presence of evolutionary concepts in European and Israeli school curricula by Mavrikaki et al. (2024), it is evident that these curricula include less than half of the learning goals considered important for scientific literacy in evolution.

In this study, knowledge of evolution is related to evolutionary topics and associated concepts such as natural selection, adaptation, including human evolution. Additionally, acceptance of evolution refers to attitudes towards evolution in general, including human evolution. In Albania, biology is taught within the "natural sciences" curriculum from preschool and primary and middle school (grades 1-9), under five major topics. Evolution is included in the diversity topic. In high school, the subject of biology in the 10th and 11th grade, covers a total of 72 hours per year, with only 4 hours dedicated to evolutionary topics. These evolutionary topics are natural selection, adaptations, and artificial selection. In the 12th grade the above-mentioned evolutionary topics are treated thoroughly, with a more profound emphasis on genetics. However, biology is not a compulsory subject, so not all students attend it. In this context, our primary aim was to examine evolutionary knowledge and acceptance among first-year university students. Therefore, the best way to approach this would be to assess it in first-year university students enrolled in biology or biology-related studies, as they are the ones who have just finished school and exhibit a special interest in biology. Additionally, we were interested in understanding the correlation between Albanian first-year students' knowledge and acceptance about evolution. The following research questions guided this study:

RQ1. What is the level of knowledge about evolution among Albanian first-year university students enrolled in biology and biotechnology programs?

RQ2. What is the level of acceptance of the theory of evolution among Albanian first-year university students enrolled in biology and biotechnology programs?

RQ3. Is there a correlation between Albanian first-year students' knowledge about evolution and their acceptance of evolution?

MATERIALS AND METHODS

Research Instrument

Data collection for this study was carried out using part of the "evolution education questionnaire on acceptance and knowledge" (Beniermann et al., 2021), a standardized research instrument designed to measure knowledge and acceptance of evolution in an international level, which consists of other "subscales" previously developed and applied. One of them is the KAEVO 2.0 (Kuschmierz et al., 2020) scale for the assessment of knowledge about evolution and the the attitudes towards evolution scale (ATEVO) (Beniermann, 2019; Beniermann et al., 2021) scale for the assessment of the acceptance of evolution, both of which we chose to use in our study.

KAEVO 2.0 is built on the framework of knowledge about evolution provided in pre-university education, based on curricula and textbook analysis. This instrument is composed of the following:

1. KAEVO-A, with 12 quiz questions, covering adaptation and natural selection (questions A1, A3, A5, and A6) biological fitness (question A2), speciation (question A4 and question A10), the heredity of phenotype changes (question A7 and question A8), human evolution (question A11), and understanding of phylogenetic trees (question A9.1 and question A9.2). All questions in KAEVO-A are embedded in a scenario-background (vignette style question) and followed by a multiple choice with only one answer as scientifically correct and also including an "I don't know" option.

2. KAEVO-B, with 12 dichotomous questions, each containing a statement of fact and being asked to indicate whether it is true or false, also including an "I don't know" option.

3. KAEVO-C, with 3 time-scale questions to draw the phase of the existence of humans on earth, the phase of the existence of dinosaurs on earth, and the origin of life on earth. KAEVO-C was not included in our research.

The 24 questions regarding knowledge were coded according to Kuschmierz et al. (2020) as 1 is scientifically correct and 0 is wrong/not known. Therefore, a person regarding his/her knowledge about evolution could get a score ranging 0-24 and would be characterized–based on a five-level classification system–from '*low knowledge*' to '*high knowledge*'.

The acceptance of evolution was evaluated following ATEVO (Beniermann, 2019; Beniermann et al., 2021), consisting of eight items with a five-point Likert scale measuring attitudes towards evolution in general and evolution of the human mind (e.g., "In my personal opinion the modern living organisms are the result of evolutionary processes which occurred over billions of years"). Answers of the 5-point Likert scale were coded as 1 is total rejection of evolution to 5 is total acceptance of evolution, therefore, the total scores for the ATEVO scale were classified as ranging from 'rejection of evolution' (score range: 8-13) to 'acceptance of evolution' (score range: 35-40) according to Beniermann et al. (2021).

Study Setting and Participants

Completion of the questionnaire has been handled according to the protocol accompanying the questionnaire (Beniermann et al., 2021) and addressed to freshmen university students who had just finished their secondary education, applying the Albanian version as a pen-and-paper survey, voluntary, anonymous, and supervised.

The questionnaire was distributed to students who were enrolled in the first year of two biology-related programs in the academic year 2023-2024, respectively, the bachelor's in biology and bachelor's in biotechnology, at the Faculty of Natural Sciences, University of Tirana. Respondents in each program represented 96% of the first-year bachelor's in biology and 93% of the first-year bachelor's in biotechnology. In total, 98 students participated in the study, 48 students enrolled in bachelor's in biology and 50 in bachelor's in biotechnology.

After digitizing the data from the respondents, the data set was observed for missing values. In this sample, 63.26% of the observations were fully completed for all items, 21.40% had one missing value and 5.10% had two missing values. In the remaining observations (11.22%) the missing values ranged from 3 to 25. After this analysis 11 questionnaires were excluded and a sample of 87 respondents was considered for further statistical analysis.

Table 1. Study's participants' profile

Characteristic	N	Percentage (%)
University program		
Biology	41	47.12
Biotechnology	46	52.87
Gender		
Male	8	9.19
Female	79	90.80
	M	SD
Age	18.95	0.78

The respondents' average age was 18.95 ± 0.78 years, with a pronounced dominance of females (90.20%), a common trend of students enrolling in biology-related programs in Albania in the last two decades. After the data cleaning procedure and exclusion of observations with more than two missing data, a total of 87 participants were considered, of which 41 (47.12%) enrolled in biology and 46 (52.87%) in biotechnology (**Table 1**).

Data Analysis

The data processing and analysis were performed in IBM SPSS 20.0. The data analysis is based mainly on descriptive statistics. The classification system related to knowledge (KAEVO scales) and acceptance of evolution (ATEVO scales) was performed based on the distribution and cumulative percentage of frequencies of the individual total scores. Testing the distribution of cases in a single categorical variable for equality across categories was performed with the Chi-square goodness-of-fit test. The mean scores of KAEVO-A and KAEVO-B scales were compared using the paired t-test. The relationships between variables of knowledge of evolution, acceptance of evolution and interest in biology were tested through Pearson correlation coefficient (r) and three-factor ANOVA.

RESULTS

The results indicate that most students have a very to rather high interest in biological topics (91.95%), which corresponds with their preference for studying biology and biotechnology; they consider themselves aware of the basic knowledge about evolution (71.26%) and that the school has contributed to their knowledge (86.21%) (**Table 2**).

However, when we measure their knowledge about evolution the results reveal a low knowledge of evolution in general (mean [*M*] = 5.00, standard deviation [*SD*] = 2.84; score range: 0-24) as also in both of the instrument's subscales: KAEVO-A (*M* = 2.97, *SD* = 1.78; score range: 0-12) and KAEVO-B (*M* = 7.37, *SD* = 1.81; score range: 0-12) (**Table 3**).

Over half of the respondents, (61.93%), present '*very low knowledge*' of evolution according to their results on the whole scale of KAEVO 2.0, (score category range: 0-

Table 2. Study's participants' perceptions regarding their interest in biological topics, self-evaluation of their knowledge regarding evolution, and whether school contributed to this knowledge

Topic	Students' answers	
	Category	Percentage (%)
Interest in biological topics	Very high	40.23
	High	41.38
	Rather high	10.34
	Medium	5.75
	Rather low	2.30
	Low	0.00
	Very low	0.00
	$X^2 = 73.8$, df = 4, p < 0.001	
Self-evaluation about evolution understanding	Yes	71.26
	Only in parts	26.44
	Thereabout	2.30
	No	0.00
	$X^2 = 74,4$, df = 2, p < 0.001	
Learning about evolution in school	Yes	86.21
	No	5.75
	Don't know	8.06
	$X^2 = 124.9$, df = 2, p < 0.001	

Table 3. Study's participants' scores for the KAEVO 2.0, KAEVO-A 2.0, and KAEVO-B 2.0 scales (Beniermann et al., 2021; Kuschmierz et al., 2020)

	Percentage (%)	Descriptive data of the sample		
		N	M	SD
KAEVO 2.0 score–Whole scale		87	5.00	2.840
High knowledge (23-24)	0.00			
Rather high knowledge (19-22)	1.15			
Moderate knowledge (15-18)	5.75			
Low knowledge (11-14)	32.19			
Very low knowledge (0-10)	61.93			
$X^2 = 91.3$, df = 3, p < 0.001				
KAEVO-A subscale score		87	2.79	1.779
High knowledge (12)	0.00			
Rather high knowledge (10-11)	0.00			
Moderate knowledge (8-9)	2.30			
Low knowledge (6-7)	4.60			
Very low knowledge (0-5)	93.11			
$X^2 = 160.3$, df = 2, p < 0.001				
KAEVO-B subscale score		87	7.37	1.812
High knowledge (12)	0.00			
Rather high knowledge (11)	2.30			
Moderate knowledge (9-10)	28.74			
Low knowledge (7-8)	39.08			
Very low knowledge (0-6)	29.89			
$X^2 = 30.6$ df = 3, p < 0.001				

10; total scores range: 0-24), and likewise, the vast majority of what remains, (32.19%), represents '*low knowledge*' of evolution, (score category range: 11-14; total scores range: 0-24). In the whole scale of KAEVO 2.0 there are no respondents with '*high knowledge*' of evolution (score category range: 23-24; total scores range: 0-24).

The mean scores of the two separate scales of KAEVO 2.0–KAEVO-A and KAEVO-B–are statistically significantly different (t = -19.465, df = 86, p < 0.001). The mean scores of KAEVO A subscale are falling into the '*very low knowledge*' score category (score category range: 0-5; total scores range: 0-12), representing 93.11% of the respondents ($X^2_{[2]} = 160.3$, p < 0.001). None in our sample scored in the top two score categories of the scale: '*high knowledge*' and '*fairly high knowledge*'.

In the KAEVO B subscale, the mean of scores is slightly higher falling into the score category of '*low knowledge*' (score category range: 7-8; total score range: 0-12). In this subscale, there is a better distribution of the representation of the three low-score categories ($X^2_{[3]} = 30.6$, p < 0.001). None from the sample falls in the score

Table 4. Study's participants' acceptance of evolution

	Percentage (%)	Descriptive data of the sample		
		N	M	SD
ATEVO score		87	30.26	3.550
Acceptance (35-40)	8.05			
Rather acceptance (29-34)	60.91			
Indifferent position (20-28)	29.89			
Rather rejection (14-19)	1.15			
Rejection (8-13)	0.00			
	$X^2 = 87.4$, df = 3, p < 0.001			

category of '*high knowledge*', while the score category of '*fairly high knowledge*' comprises of only 2.30% of the sample.

From the results presented in **Table 4** we read that the majority of students (60.91%) accepts that evolution occurs, and it is a natural process (*M* = 30.26, *SD* = 3.55). However, their acceptance of evolution is uncorrelated to their knowledge of evolution (r = -.018, df = 87, p = .868). Similarly, students' interest in biology seems uncorrelated to their knowledge about and acceptance of evolution (p > .05).

DISCUSSION

The Albanian students in our sample exhibit a '*very low knowledge*' of evolution as measured by KAEVO 2.0 (Kuschmierz et al., 2020) with a small variation for the two subscales of the instrument falling into the '*very low knowledge*' score category for KAEVO-A and the '*low knowledge*' for KAEVO-B. This difference in the two subscales measuring evolution understanding can be explained by the fact that questions in KAEVO-A are presented in a scenario background (vignettes) and each question was in a multiple-choice format minimizing the possibility that a respondent chooses the correct answer by pure chance compared to the KAEVO-B questions that were dichotomous. Furthermore, the dichotomous statements included in KAEVO-B were easier to answer, as the respondents could easily recall the specific information in their memory.

We should take under consideration that the sample in our study consisted of first-year university students that are enrolled in biology or biotechnology programs and exhibit a high interest for biology. As Mavrikaki et al. (2024) mention, evolution in Albanian schools is taught 4 hours in high school for all students, and only those who choose the subject of biology in the 12th grade have the chance to study it deeply. This means that students in our sample although they had the chance to dive into the concepts of evolution was done only very late during their schoolyears and this could be the reason for their low scores. Research has revealed that teaching evolution since elementary school can be effective (Campos & Sá-Pinto, 2013; Sá-Pinto et al., 2021) and maybe could contribute to a better understanding of evolution later in life. So, given that Albania scores very low in comparison to many other European countries

(Kuschmierz et al., 2021) we suggest that an earlier inclusion of the evolutionary concepts to the Albanian school curriculum of elementary or lower secondary education could contribute to a better understanding of the theory of evolution later in life.

Regarding acceptance of the theory of evolution, the Albanian first-year university students that participated in our research although many of them (60.91%) accept evolution scored low on the acceptance scale (ATEVO) ($X^2_{[3]}$ = 87.4, p < 0.001) scoring lower than almost all their colleagues in the other European countries (Kuschmierz et al., 2021). As Grossman and Fleet (2017) suggest increased coursework on evolution topics may increase acceptance of evolution and around 14% of our sample has not been taught about evolution in school. Therefore, an increase in the number of hours dedicated to evolutionary topics in school is recommended which could have a direct influence on students' knowledge. It is also important to take into consideration that there exists a wide gap between Darwin and evolutionists today, shaped by deep conceptual/structural differences between now and then, and in standard textbooks and popular literature, evolutionary theory needs a profound rethinking, incorporating philosophical methodology and dialogues in the classroom (Bernhard et al., 2023; Czaja, 2023).

CONCLUSIONS

Our results showed that Albanian first-year students enrolled in biology and biotechnology courses at the University of Tirana, had a '*very low knowledge*' of evolution as measured by KAEVO 2.0. Results exhibit small variation for the two subscales of the instrument falling into the '*very low knowledge*' score category for KAEVO-A and the '*low knowledge*' for KAEVO-B. Additionally, students' interest in biology seems uncorrelated to their knowledge about and acceptance of evolution (p > .05). In the future, the analysis should be extended to a broader sample of first-year Albanian students in other faculties to determine if our results can be confirmed on a greater scale, and to different scientific backgrounds (ex. students in sociology or psychology courses). Additionally, further investigations should focus on the student's scientific reasoning skills as results indicate for KAEVO-A. These results could be explained by the late inclusion of the evolutionary

concepts in Albanian school curricula and the decreased number of hours dedicated to evolutionary concepts in school.

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