

# The Teaching of Biological Evolution: is it essential to the scientific progress?

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## Abstract

*Nowadays the teaching of biological evolution faces the creationist movement that claims this theme has no scientific evidence and that it could be excluded from the educational system. A challenging question about whether the exclusion of the teaching of Darwinian Evolution would harm the scientific progress was asked to a Brazilian population sample. In general, the results showed a rejection of the above question. Among the religious respondents, Spiritualists were those showing higher acceptance of the proposed statement whereas the Evangelicals were those less agreeing with the proposed question and with a considerable percentage of disagreement; Catholics were in a median position, agreeing with the question and a few rejecting it. The more educated the respondents were the higher acceptance of the question. The present study revealed that even the inquired creationists recognize that the teaching of biological evolution is essential in modern science.*

## 1. Introduction

Supported by a large body of evidence, the topic of biological evolution has become a major pillar of modern science. Indeed, it is hard to find a student that has not been in contact with the Darwinian Theory in his/her academic path anywhere in the world [1]. There is a network of evidences leading to concepts that underpin the evolutionary theory, which in turn sustain theoretical models allowing

predictions. Such predictions when confronted by new empirical results may or may not generate changes in the models. Much of Darwin's contribution to science was just to be able to gather a series of observations coming from different fields and synthesize them to explain the common ancestry [2].

Berkman and Plutzer [3] claim the importance of the teaching of biological evolution in the curriculum, especially in secondary school, due to its unifying role in biology. These authors also emphasize the role of Darwinian Theory to show students how modern science works and how it is essential to the understanding and progress of biological areas such as genetics, agriculture and health, among others.

In 2009, a series of celebrations for the anniversary of the birth of Charles Darwin and the release of the most impactful book "The Origin of Species" took place. Since the publication of this book the issue of Darwinism and the teaching of evolution was in vogue both in scientific and lay media [4]. On the other hand, there has been a strong reappearance of creationist movements, being initially limited to the United States, but currently echoing around the world, and most notably in Brazil [6]. This rebirth of the creationist view may come from a reaction to the confirmation of the importance of Darwinism, especially in the educational field [3], but may also be related to more fundamentalist religious view, highlighting the biblical text as the only reliable source of knowledge and moral stance [5].

The creationist movement has many facets, more or less radical. One must be careful with generalizations but, in general, these movements are aggregated into a global trend, which refuse definitely the Darwin's ideas about the evolution of species, notably with regard to the human origin [5]. This rejection leads to deficiency of basic knowledge of modern biology, which is takes evolution as its guiding principle. So taking the creationists arguments would refute the current way of doing science, with its network of experiments and results that mutually support themselves [2].

The creationist movement has found field in Brazil, with the growing number of faithful and, especially, evangelical churches, which are mostly rooted in the literal interpretations of the biblical text. This growth is reflected in the political field and also in the educational field, with proposals for teaching creationism outside the scope of religion classes, being seen as an element of balance to the prevalence of biological evolution, even in science classes [2, 6].

In this whole situation of conflict between evolutionists and creationists, a survey in the UK in 2009 entitled "Rescuing Darwin", which resulted in a report of the same name was made. The research sought to capture the vision of the British population about Darwinian biological evolution; the results revealed a high alignment with creationist thinking and reject the ideas of Darwin [7]. Despite the semantic problems that any question of that report may have on inducing the respondents' reaction, some questions of that survey were replicated in Brazil and other questions of local interest were added [6]. Part of the motivation of this research derives from the Colombo's hypothesis [8] suggesting that the results would be different in the Brazilian population due to its religious spectrum would agree more with creationist ideas and would be more resistant to evolutionary approaches, which was not sustained with recent results obtained by [6].

In the present study a survey in the central-west of the Minas Gerais (MG) State, Brazil, and in its metropolitan region of Belo Horizonte was carried out by using a questionnaire containing the tenth question of Colombo's questionnaire [8]. "Some people argue that the teaching of evolution can be beneficial for the scientific development of mankind, and eliminate it would be harmful; on these arguments you...". This question aims at analysing whether the Brazilian population – with varied education levels and high religiosity (<http://censo2010.ibge.gov.br/noticias-censo?id=1&idnoticia=2170&view=noticia>) – consider the teaching of biological evolution beneficial and if its elimination would bring any harm to science and, in the first instance, to students' biology learning.

## 2. Methodology

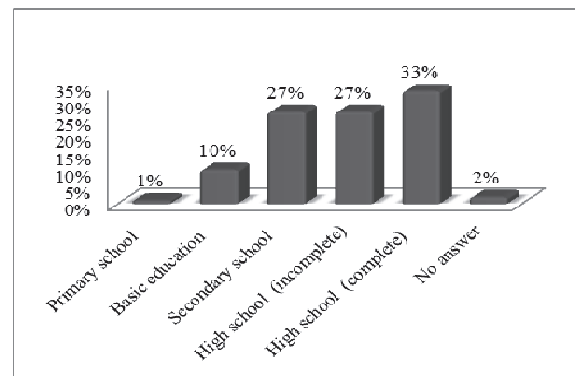
The research took place in Itaúna and Formiga municipalities (MG State), covering the region of central-west MG State and its metropolitan area of Belo Horizonte.

The data collection instrument was a questionnaire with eleven multiple choice questions, of which the first four are literal translations of the English Colombo [8]'s questionnaire plus seven questions formulated specifically for this research. It consisting of a series of statements contained questions on the Likert scale format, in which the respondent should express their degree of agreement or disagreement each statement. It was validated by applying the Cronbach alpha test, obtaining the value of 0.617 [9].

The instrument was completed by 390 respondents, the majority (62.6%) were female. The average age of respondents was 30.7 years. No specific criteria for questionnaire application were predetermined.

## 3. Results and discussion

The questionnaire data analysis showed that, within the sample studied, there is an outstanding recognition of the importance of Darwinian theory to scientific progress, with 89% of respondents considering that the proposed statement is definitely true (66%) or probably true (23%) (Figure 1).



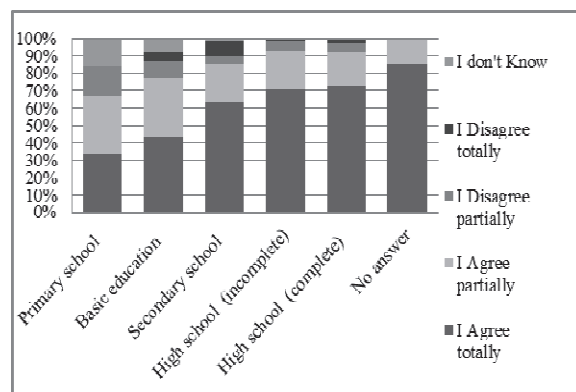
**Figure 1.** Respondents' answers to the question whether the teaching of evolution can be beneficial for the scientific development of mankind and eliminate it would be harmful.

These results seem to disagree with previous ones found by Silva et al. [6, 9] regarding the rejection of evolutionary theory or the failure to consider a creator in the emergence of species, using the same questionnaire applied to the same public but when was analysed other question. This contradiction may be due to the fact that even being highly religious, the biology teachers recognize the importance of Darwinian Theory to the teaching of biology and

science as a whole, as suggested by Bizzo et al. [4] in an extensive survey of Brazilian students. According to Ian Barbour [10] these contradictions can be resorted through the relations between science and religion that can be categorized in four main groups: conflict, independence, dialogue and integration.

It can be suggested that the category of independence gives a possible answer to the contradiction that seems to have arisen when creationists recognize the value of teaching evolution. For these respondents, even preserving their dogmatic worldview, it is possible to recognize and live with knowledge that could bump into their faith and recognize their importance, as perceived by Bizzo et al. [4]. To go further in the analysis of the results on this issue, two variables in the survey were analysed: respondents' education and religiosity.

Figure 2 shows that the increase in education has a positive impact on recognition of the importance of Darwinian Theory. Respondents with less education showed a higher rate of the sentence rejection and had more difficulty to opine. With the increase in their academic career, the proportion of the sentence acceptance tended to increase, although the statistical analysis showed no significant differences ( $p > 0.05$ ; Table 1). Therefore one cannot say that the level of education affects directly the sentence acceptance or rejection. It must be emphasised that the samples for each category were not predetermined, i.e. the sampling procedure, on purpose, did not take into account the level of education or religion as criteria for inclusion. Nonetheless, these results are in agreement with those found by Silva et al. [6, 9], with respect to increasing education contributes to acceptance of evolutionary ideas.



**Figure 2.** Respondents' answers to the question whether the teaching of evolution can be beneficial for the scientific development of mankind and eliminate it would be harmful, by education level.

A significant increase in the statement acceptance was found at the education level of high school. It becomes clear the influence of studying biological evolution (at High School) on students' ideas about it, who recognize better its relevance as a priority in the Brazilian secondary school curriculum proposal

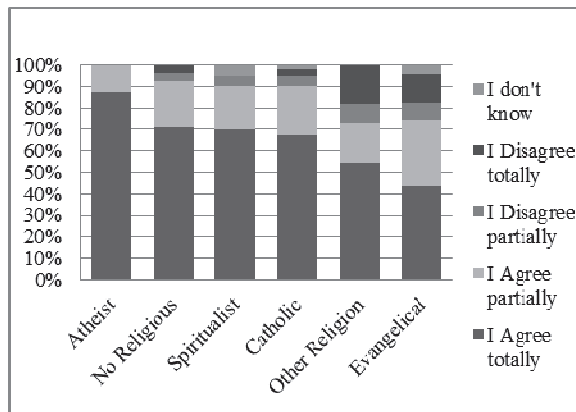
(<http://portal.mec.gov.br/seb/arquivos/pdf/ciencian.pdf>).

**Table 1.** Chi-square test in relation to education, with a significance level of 5% and degree of freedom 20.

Sample	I agree totally	I agree partially	I disagree partially	I disagree totally	I don't Know
Primary school	2	2	1	0	1
$\chi^2_{\text{partial}}$	0.99	0.31	1.56	0.23	6.25
Basic Education	17	13	4	2	3
$\chi^2_{\text{partial}}$	3.06	2.00	2.00	0.17	6.05
Secondary School	66	24	4	9	2
$\chi^2_{\text{partial}}$	0.20	0.00	0.36	6.10	0.01
High School (incomplete)	74	23	5	1	1
$\chi^2_{\text{partial}}$	0.35	0.01	0.02	2.25	0.60
High School (complete)	94	25	6	3	1
$\chi^2_{\text{partial}}$	0.81	0.58	0.06	0.78	1.02
No answer	6	1	0	0	0
$\chi^2_{\text{partial}}$	0.39	0.21	0.36	0.27	0.14
<b>Total</b>	<b>259</b>	<b>88</b>	<b>20</b>	<b>15</b>	<b>8</b>
$\chi^2_{\text{calculado}}$	37,14				

These results support Berkman and Plutzer's [3] claim about the increase of the teaching of biological evolution in the curriculum, especially in secondary school, and the need for improving teachers' competencies on this subject, so that they can work better with their students in the process of teaching and learning.

The Colombo [8] analysis of the English report "Rescuing Darwin" claims that there would be greater acceptance of Darwinian Theory among Spiritualists, because the followers of this doctrine are less compliant to the scientific issues. In fact, the present study also shows that of the religious groups (i.e. excluding atheists and non-religious respondents), the Spiritualists were those who showed greater agreement with the statement (70.0% "I agree totally" + 20.0% "I agree partially") and no rejection was found (Figure 3). In contrast, the greater rejection to the statement occurred among Evangelicals (8.7% "I disagree totally" + 13.0% "I disagree partially"), but even among these, there was a small proportion (30.4% "I agree partially") recognising the value of evolutionary theory in the today's world (Figure 3). The Catholics were in between Spiritualists and Evangelicals (67.3% "I agree totally" + 22.7% "I agree partially" and 5.0% "I disagree totally" + 3.0% "I disagree partially"). These results agree with those found by Bizzo et al. [4].



**Figure 3.** Respondents' answers to the question whether the teaching of evolution can be beneficial for the scientific development of mankind and eliminate it would be harmful, by religion.

According to the last Brazilian census (<http://censo2010.ibge.gov.br/noticias-censo?view=noticia&id=1&idnoticia=2170&t=censo-2010-numero-catolicos-cai-aumenta-evangelicos-espiritas-sem-religiao>), Evangelicals are the fastest growing religious group and those declaring having no religion are growing in numbers. Those who called themselves Atheists in this work agreed very much to Darwinian Theory and its importance to the modern world (100% of "I agree totally"+ "I agree partially") (Figure 3). Thus, if the fastest growing population groups in Brazilian society are the Evangelicals (the most reluctant to Darwinian Theory) and the Atheists (the most aligned to Darwinian Theory) there will be a tendency for the polarization in the Brazilian religious field, which can lead, in the future, to problems in relation to teaching this subject.

The chi-square test showed that the religion variable had a high impact on agreement or disagreement with the statement of the role Darwinian Theory in modern science suggested in the questionnaire ( $p < 0.05$ ), confirming the initial hypothesis of this work.

Matching data of religion and education, it could be noticed that even among those belonging to the most aligned to creationism religions (Evangelicals), when having higher levels of education could recognise the value of Darwinian Theory to scientific development. So here is again the category of independence between science and religion proposed by Baubour [10], suggesting that even the most religious persons, when having contact with the Evolutionary Theory through regular education, can live with two apparently opposite views, being able to recognise the value of each one. This refutes the modern creationist movement claim that the Evolutionary Theory is incompatible with having a religion. Another recurring dogma is that evolution does not have scientific support [3], but data of this research showed that respondents with higher

scientific educational level, even of creationist groups, recognise the relevance of Darwinian Theory and its importance to the modern world.

#### 4. Conclusion

Most respondents can accommodate their religious dogmatic view built during their life with the scientific knowledge acquired at school and even when it seems to contradict their faith. This reveals some degree of independence between the two fields, religion and science. Results showed that for all Brazilian religious and non-religious groups there is room for the perception of the impact that Darwinian Evolutionary Theory has in modern science. This conclusion contradicts the view of some groups of radical atheists that claim the need to eliminate any trace of religiosity in school to allow accepting the idea of evolution and the humans' origin, i.e. assuming the idea of conflict between Science and Religion [10]. Finally, in contrast to the most radical creationists' claim, this study suggest that even in the view of those who profess a religion, the absence of teaching of biological evolution in school can be a harm for the regular education and for the scientific development.

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