"Evolution? I Don't Believe in It"

Merav Siani & Anat Yarden

Science & Education
Contributions from History, Philosophy and Sociology of Science and Mathematics

ISSN 0926-7220

Sci & Educ
DOI 10.1007/s11191-020-00109-7

Springer

Science & Education
https://doi.org/10.1007/s11191-020-00109-7

ARTICLE

"Evolution? I Don't Believe in It"

Theological Tensions Surrounding the Implementation of Evolution in the Israeli Curricula

Merav Siani[1,2] · Anat Yarden[1]

Abstract
Due to the controversies surrounding the topic of evolution among religious and non-religious people alike, the treatment of biological evolution in education—both teaching and learning—is a potential minefield. The goal of this study was to probe the insights of Israeli stakeholders in education regarding the revision of the Israeli science and technology and biology curricula with respect to evolution. Our study is designed to capture the educational stakeholders' opinions regarding the theological tensions surrounding the incorporation of evolution in the curricula, as well as methods of action to overcome or avoid these possible tensions. The study population was composed of 21 educational stakeholders, 11 of them scientists, developers of teaching and learning materials, and current or former chief supervisors at the Israeli Ministry of Education. These stakeholders were interviewed in-depth. The other 10 stakeholders were junior-high-school science or high-school biology leading teachers, for which focus groups were arranged. To obtain the main themes arising from the interviews, thematic analysis was conducted, and codes were obtained by grounded theory analysis. The results show themes of opposition to teaching evolution, a clear voice for no opposition to teaching evolution, and methods of action to overcome or avoid tension at the teacher and student levels. We suggest a culturally competent intervention program to reduce the dissonance between religion and evolution.

Keywords Evolution · Theological tension · In-depth interview · Educational stakeholder · Curriculum

✉ Merav Siani
sianimerav@gmail.com

Anat Yarden
anat.yarden@weizmann.ac.il

[1] Department of Science Teaching, Weizmann Institute of Science, Rehovot, Israel

[2] Herzog College, Alon Shvut, Israel

1 Introduction

Evolution has been a controversial topic for approximately 150 years. The controversies are rooted in a battle of ideas between traditionalism and modernity, and even between science and religion (Berkman & Plutzer, 2010; Lyons, 2010). In fact, it is controversial among both religious (Hill, 2014; Rissler, Duncan, & Caruso, 2014; Williams, 2015) and non-religious (Unsworth and Voas, 2018) individuals. Forces in different countries across the globe have worked to delegitimize and obstruct the teaching of evolution (Hall & Woika, 2018; Skoog, 2005). Moreover, the fact that we are related to other creatures and that we are the product of evolutionary forces is hard for people to accept, since according to evolution, we are the outcome of natural selection, making us less unique (Coyne, 2012). Students have difficulty seeing the relevance of evolution to their everyday lives (Heddy & Sinatra, 2013), and initially hold "Lamarckian" preconceptions about evolution (Kampourakis & Nehm, 2014). Moreover, much of the general public's understanding of evolution is based on misinformation about what the theory claims (Lyons, 2010). This complexity of religious tensions, as well as the topic's delegitimization, decreased relevance, preconceptions, and misinformation, all make evolution education a challenging task (Kampourakis, 2015). Thus, the introduction and implementation of evolution in a school science curriculum has to be approached with cultural sensitivity (Barnes & Brownell, 2017) and with knowledge of the tensions that might arise in the specific target population (Owens, Pear, Alexander, Reiss, & Tal, 2018; Pear, 2018; Pear, Klein, & Berger, 2015).

According to Moore (2008), European secondary-school students leave school without fully understanding how well-supported evolutionary theory is. Moreover, research has found that many high-school teachers are not scientifically capable of teaching evolution using modern approaches (Glaze & Goldston, 2015; Moore, 2008), and topics such as molecular evolution are only properly introduced at the college undergraduate level (Ziadie & Andrews, 2018).

In Israel, all of the curricula, including science and technology for junior high school and biology for high school, are centrally written by a team led by the chief supervisor at the Ministry of Education. The team is composed of developers of teaching and learning materials, scientists involved in education, and experienced science teachers. All of these groups are referred to in this article as educational stakeholders, and as such, we sought their opinions regarding the introduction of evolution, which was declared a compulsory topic in the Israeli science curricula.

We traced the educational stakeholders' insights about pedagogical considerations regarding the implementation of evolution in the junior-high-school science and technology curriculum and in the high-school biology curriculum, as well as on possible tensions with respect to theological components regarding the implementation. In this article, we focus on the second topic.

2 Theoretical Background

2.1 Tensions Surrounding the Teaching of Evolution

Evolution has been a controversial issue for years; most of the uncertainty and disagreement stem from opposing sides of the evolution/creationism issue, as observed in England in 2002

(Allgaier, 2010), among Muslims (Edis, 2008), and among people from 34 countries (Miller, Scott, & Okamoto, 2006). However, in addition, the general population does not have a strong understanding of evolution, and a lack of understanding is a common reason for rejection of, or ambiguous feelings about an issue (Kampourakis & Strasser, 2015). There is also some uncertainty and disagreement among scientists regarding evolution, which complicates the situation (Hermann, 2008). Differences of opinion between individuals within a society regarding evolution (Owens et al., 2018) are also reflected as socially controversial among teachers and students (Reiss, 2011).

Opposition to evolution has been found in Europe, where creationism is widespread among religious populations such as in Turkey, where only 22% of the adults agreed with Darwin's theory (Blancke, Hjermitslev, Braeckman, & Kjærgaard, 2013). Such opposition has recently been found also in Britain, where Muslims and conservative Protestant Christians show low levels of evolution acceptance (Unsworth & Voas, 2018). Among Muslims in Britain, the popularity of creationism has risen, with the combination of higher education and high religiosity corresponding to the lowest levels of evolution acceptance (Unsworth & Voas, 2018). Moreover, it has been found that many people hold non-confident or inconsistent views of evolution, with similar levels of uncertainty about the earth's age found across religious and non-religious groups alike (Unsworth & Voas, 2018).

The most threatening aspect of evolution theory is the notion that in order to accept evolution, one must become an atheist (Lyons, 2010). For that reason, students' religious beliefs and religious cultures have been shown to be the main factors predicting whether they will accept evolution (Hill, 2014; Truong, Barnes, & Brownell, 2018; Unsworth & Voas, 2018). In addition, acceptance of evolution correlates negatively with religious faith and positively with attitudes to school science and to the understanding of evolution (Eder, Seidl, Lange, & Graf, 2018). Many religions deny evolution by stating that a deity created us, whereas other religions have found ways to accommodate evolution in their spiritual beliefs, for example by convincing religious people that neither evolution nor science pose threats to their faith (Coyne, 2012). Even though scientists have found plentiful evidence for the accuracy of evolutionary theory, Americans are still very suspicious of this part of biology (Coyne, 2012).

Understanding the differences between various religions and their beliefs can help us understand the manner in which individuals relate to the tension between faith and science (Dickerson, Dawkins, & Penick, 2008). Most of the Orthodox Jews, except for the Ultra-orthodox, accept the main parts of evolution theory such as species transformation, emphasizing that science complements religion, creating a synthesis of the sacred and secular. For them, evolution is a progressive, goal-directed process, with God as the driving force (Dodick & Shuchat, 2014; Swetlitz, 2013). This approach has been accepted by rabbis such as Abraham Isaac Kook who thought that the Jewish tradition provides a theological framework, whereas the progressive evolution of species could be integrated into a larger vision of spiritual elevation (Cho, Lankford, & Wescott, 2011; Pear et al., 2015). Other rabbis have argued that evolution can even strengthen Jewish faith (Pear et al., 2015). On the other hand, the Ultra-Orthodox Jewish community is characterized by a strong and widespread opposition to evolution (Pear, 2018). In the early 1960s, Moshe Feinstein, a well-known Ultra-Orthodox rabbi, ruled that teachers should tear pages from textbooks that teach heresies regarding the creation of the world. Ultra-Orthodox Jews, such as the late Lubavitcher Rebbe, oppose the theory of evolution (Pear et al., 2015), since they look to the Torah and its traditional commentaries for knowledge about the earth's history and the history of life, stating that

scientific evidence for evolution was weak and that Judaism requires a young-earth creationism (Swetlitz, 2013).

Taking rabbinical statements into consideration, Jewish religious teachers in Israel, most of them biology teachers or physics, chemistry and geology teachers, were questioned about evolution (Dodick, Dayan, & Orion, 2010). Among them, the age of the earth was found to be a controversial issue. Approximately half of the teachers surveyed saw a conflict between the theory of evolution and biblical creation. For some of them, the random nature of the former contradicted the belief in creation directed by the 'hand of God', or they were opposed to the possibility of evolution of man from apes. Admittedly, some of these teachers were not familiar enough with evolution or the account of creation from the book of Genesis to say whether a real contradiction existed (Dodick et al., 2010).

In addition to the described tensions, among Israeli students, there might be another obstacle. In contrast to most schools in the US, where no religious content is taught in state schools, students in Israeli secular state schools study the biblical creation story as part of their obligatory bible courses in the second and tenth grades (Israeli Ministry of Education, 2019). This might worsen the perceived conflict between evolution and religion, since the students get different and seemingly contradictory explanations for the question of the beginning of life within the school framework.

The attitude of Muslims to evolution has changed over the last decade. Whereas a decade ago, relatively poor education standards, combined with frequent misinformation about evolutionary ideas, made the Muslim world a fertile ground for rejection of the theory (Hameed, 2008), with many Muslims opposing Darwinian evolution (Edis, 2008), today the situation is more diverse and complex. Religious affiliation and frequency of prayer, together with education, have been found to be key predictors of the acceptance or rejection of evolutionary theory; yet, the issue of evolution does not seem particularly prominent for Muslims in Britain. For example, only 10% accept the evolution of plants and animals while rejecting human evolution (Unsworth & Voas, 2018). Another study following Muslim teachers' conceptions of evolution in several countries found complex results: in the sub-Saharan countries, teachers' conceptions were less creationist than in Arabic regions such as the Maghreb and Lebanon. Analysis showed two main effects on the acceptance of evolution: the country effect and that of the degree of belief in God and religious practice. For example, in Lebanon, Muslim teachers were more creationist than Christian teachers but more evolutionist than their Protestant colleagues. In Burkina Faso, it was the other way round: Muslim teachers were less evolutionist than their Protestant colleagues (Clément, 2015). More than 70% of Malaysian teachers agreed with the statement "It is certain that God created life," and Malaysian teachers may therefore have difficulty teaching evolution, because creationism is not scientific and cannot be taught in biology. Nevertheless, with respect to the origin of life as well as the origin of mankind, 21% of the Malaysian teachers were evolutionist as well as creationist. They could accept and teach evolution, while believing that the processes of evolution are controlled by God (Yok, Clément, Leong, Shing & Ragem, 2015).

2.2 Overcoming the Tensions Surrounding Evolution

Although all of these sources show that tensions surrounding evolution are widespread throughout all religions, analysis has revealed acceptance of evolution among a high proportion of students, especially Christian ones (Unsworth & Voas, 2018). Their acceptance has increased due to changes in their understanding of the evidence for evolution, and of the ways

in which they can relate evolution to their religious beliefs, rather than to changes in their religious beliefs (Yasri & Mancy, 2016). Furthermore, among Christians, when the teachers taught in a culturally competent way, student acceptance increased (Barnes & Brownell, 2018). Culturally competent learning is defined as knowing and facilitating the varied range of students' cultural and linguistic groups in the learning process (Barnes, 2006). Another possible way of reducing the distance between science and religion is by introducing science students to philosophical aspects of research in evolutionary biology. Since the philosophical aspects help the learner understand how science itself works, using biological theories of the origin of religion might aid in overcoming tensions in the field of evolution (Pigliucci, 2013).

In addition to cultural sensitivity and introduction of the philosophical aspects of evolution, deep knowledge of both scientific and religious sources was identified as a key tool in coping with the opposition to evolution. A survey was conducted among religious Jewish science teachers, many of whom had received training in a religious seminary that rarely dealt with the philosophical problems between science and religion. The teachers favored approaches that integrate science and religion with the aim of settling their internal conflict, while providing them with the tools to teach such conflicting subjects with confidence (Dodick et al., 2010). Additional research has found that the level of acceptance is not solely a result of identity factors, such as high levels of religiosity and conservative views; knowledge of evolutionary theory plays a significant role in the acceptance of evolution when positive relationships have been found between acceptance of evolution and performance on knowledge tests (Weisberg, Landrum & Metz, 2018).

However, attempting to directly and quickly change someone's mind about knowledge regarding evolution is not easy, because it involves both religious and political elements. School science teachers and their students have systems of meanings and understanding that are integrated in life-long social relationships and are not easily changed by educational treatment (Long, 2012).

2.3 Evolution Curriculum

Being a controversial issue, the implementation of evolution in science curricula and subsequently in the classroom is a topic of debate worldwide, including Israel. Rutledge and Mitchell (2002) argue that teachers' attitudes and views of subject matter can affect their curricular and instructional decisions; thus, if a biology teacher rejects the scientific validity of evolutionary theory, this might influence the place occupied by evolution in the learned curriculum (van den Akker, 2003). Consequently, while writing the science curriculum, it is important to better understand science teachers' attitudes to science (Dodick et al., 2010), so that the curriculum will suit these attitudes, and might be promoted from a 'recommended' curriculum to a 'taught' one (Glatthorn, Boschee, Whitehead & Boschee, 2018).

In the last few decades, evolution has not been an integral part of science or biology curricula in many countries. It is one of the four core ideas of biology instruction included in the Next Generation Science Standards (2013), and it is certainly a vital element of science literacy. Yet, in some states in the US, legislation prevented teaching it. For example, Kentucky had laws, originally enacted in 1976, authorizing teachers in the state's public schools to present biblical creationism. Recently, these laws have been changed and the *Next Generation Science Standards* (NGSS) were approved by the Kentucky Board of Education (Kentucky Department of Education, 2013). As well as that, Louisiana and Tennessee have lately, in 2008

and 2012, respectively, passed legislation encouraging teachers to discuss scientific evidence critical of evolution (Hall & Woika, 2018).

In 1920, and for about a decade thereafter, the state of Oklahoma outlawed textbooks that mentioned evolution, and the state of Tennessee forbade teaching it, as did Mississippi and Arkansas (Francis, 1995), for at least 20 years (Masci, 2014). For long periods in America's history, the teaching of evolution was excluded from the standard science curriculum due to legislation, and to schools' and teachers' unwillingness to become involved in a controversial issue (Hall & Woika, 2018). The topic of evolution appeared in force after the launch of Sputnik by the Soviet Union in 1957, which prompted the critical analysis of science curricula in US public schools and the establishment of the Biological Sciences Curriculum Study (BSCS) in 1958 (BSCS Science Learning, 2019). The BSCS led a movement to increase the focus on evolution and thus publishers began to include evolution in new textbooks adopted by public schools. Nevertheless, three states, Tennessee, Arkansas and Mississippi, still have laws interfering with the teaching of evolution in public schools, leading to some teachers choosing not to include evolution education (Hall & Woika, 2018).

Similarly, in South Africa, after being excluded from the school curriculum for almost 50 years for political and religious reasons, evolution was introduced into the school curriculum about 10 years ago, at both junior and senior levels (Sanders, 2018). Between 1948 and 1994, the strongly religious governing National Party in South Africa controlled the education system. Ideological, historical, social, political, and cultural circumstances led to their strong anti-evolution position (van den Heever, 2009). On the other hand, in Greece, there are no particular religious influences against the teaching of evolution. However, content about evolution is only included in the last chapters of science textbooks (Stasinakis & Kampourakis, 2018).

As part of the renewal of evolution in the last two decades, a survey of science standards in 50 US states was conducted (Skoog & Bilica, 2002). The presence of the following concepts and processes was checked in these 50 documents: species evolve over time, speciation, diversity of life, descent with modification from common ancestry, evidence of evolution, natural selection, pace and direction of evolution, and human evolution. These concepts and processes were not emphasized equally in the examined documents. For example, human evolution was included in only seven documents. The word evolution was absent from some documents; yet, the 50 documents emphasized evolution in a manner that suggested that it should be studied in US schools (Skoog & Bilica, 2002). Another study relating specifically to human evolution showed that prior to the 1960s, US biology textbooks placed little emphasis on human evolution. In the 1970s and early 1980s, textbooks reduced the coverage of human evolution. During the late 1980s, the emphasis on evolution and human evolution in most textbooks in the US increased and persisted, despite the continued efforts of special interest groups to minimize or neutralize the teaching of evolution in American public schools (Skoog, 2005). In the 1990s, the coverage became quite comprehensive; yet in 2004, the state science frameworks of only three states had standards relating to human evolution (Skoog, 2005).

Content analysis of 14 sets of biology textbooks published in Hong Kong monitored their coverage of evolution between 1991 and 2016. This analysis showed that the depth and extent of this topic have been growing over the years, with an increase in the variety of learning strategies and activities used in the field of evolution (Cheng & Chan, 2018). Similar research from a few European German-speaking countries (Germany, Austria, Switzerland, and

Luxembourg) showed that since 1970, there has been more student acceptance of evolution, as well as more suitable teaching materials in most of those countries (Eder et al., 2018).

A recent review comparing the high-school biology curricula in Australia, England, Virginia, and California in the US, New Zealand, Singapore, Scotland, Finland, and the Canadian Province of British Columbia showed that the writers of the curricula in these regions, in which a large proportion of citizens define themselves as religious, have understood that evolution is a central concept in biology and not just a theory responsible for the collision of science and religious beliefs. The topic of evolution was part of all curricula checked in those countries (Zer Kavod, 2018).

2.4 Types of Curricula

Since we are dealing with the inclusion of evolution in Israeli curricula, it is important to relate to the types of curricula, prior to exploring the change that has recently occurred in the Israeli ones. Curriculum refers to the individual's total learning experience, not only at school but also in society (Kranthi, 2017). As such, the curriculum represents the expression of educational ideas that are being put into practice, and includes all of the planned learning experiences of the educational system.

Goodlad (1979) and Glatthorn et al. (2018) present a few types of curricula; herein, we use the Glatthorn terminology. The 'recommended' curriculum is the official one, which has been approved by the state, indicating what ought to be taught, what a student at the relevant age should know. Another type of curriculum is the 'taught' curriculum, which is the one that is actually being taught—what goes on in schools and in the classroom. The way the material is taught is usually left entirely to the teachers' discretion. Another type is the 'learned' curriculum, which includes the changes in values, perceptions, and behavior that occur as a result of the school experience (Glatthorn, et al., 2018). It has been found that teachers' conceptions of teaching and learning influence the way in which they implement an instructional design into real lessons in the classroom (Suprayogi, Valcke, & Godwin, 2017; Trigwell, Prosser, & Waterhouse, 1999). In Israel, as elsewhere, there is a gap between the 'recommended' curriculum and the 'taught' curriculum.

Given the above, curriculum development is a complicated mission, and therefore, a few groups of stakeholders take part in this task so as to take into consideration the society's interests, beliefs, values, and attitudes.

2.5 Why Is the Stakeholders' Opinion Important?

Stakeholders are defined as "any group or individual who is affected by or can affect the achievement of an organization's objectives" (Freeman, 1984 pp.5), a general definition that includes stakeholders of educational systems as well. The stakeholders recommend and plan new directions for a firm (Freeman & McVea, 2001; Kerzner, 2017) and develop and implement their strategies by developing collaborative relationships with the stakeholders in their firms (Crane & Livesey, 2017; Svendsen, 1998).

Similarly, in the educational sector, educational stakeholders as those who are involved in planning and implementing new curricula in the educational system, while taking into consideration its needs and objectives (Birdthistle, Hynes, & Fleming, 2007; DeJaeghere, Chapman, & Mulkeen, 2006). Much has been written about the contribution of stakeholders, identified as teachers and students, to learning environments and to participatory design

(Könings, Seidel, & van Merriënboer, 2014). Another group of stakeholders who have researched the scientific ideas that should be taught in school science includes science educators, scientists and even historians, philosophers and sociologists of science, as well as experts engaged in work to improve the public's understanding of science (McComas & Olson, 1998; Osborne, Collins, Ratcliffe, Millar, & Duschl, 2003). In one study, high-school teachers, along with scientists, science-education researchers, and science-teaching educators, made up the group of stakeholders who identified a core set of science-teaching practices (Kloser, 2014).

In this study, to listen to the voice of stakeholders on the inclusion of evolution in the Israeli science and technology as well as biology curricula, we focused on educational stakeholders: some work at the Ministry of Education, some are developers of learning and teaching materials in science, and some are junior-high-school science and technology and high-school biology teachers. The supervisors at the Ministry of Education and those who develop scientific teaching and learning materials represented those who design the 'intended' curriculum, while the teachers expressed the voice of the 'implemented' curriculum (van den Akker, 2003); to get a broad picture, we listened to them all.

3 Aim and Research Questions

The Israeli junior-high-school science and technology curriculum and high-school biology curriculum underwent changes in 2016. Prior to this time, the term evolution was mentioned only in the core section of the curricula and was included as an elective topic. As of 2016, evolution has become a compulsory part of the curricula.

The aim of this study was to trace educational stakeholders' opinions regarding the change in the Israeli Ministry of Education's junior-high-school science and technology curriculum (Ministry of Education, 2016b) and high-school biology curriculum (Ministry of Education, 2016a), in which evolution was declared a compulsory topic. In Israel, all junior-high-school students, including the Ultra-Orthodox, study according to the same science and technology curriculum regardless of their religious affiliation. This is different from the curricula of history, biblical studies, and other subjects that differ for the Jewish religious sector, the Jewish secular sector, and the Arab sector. High-school level biology is also identical for all sectors, but is an elective subject at the 10th to 12th grade levels.

According to the Israeli Central Bureau of Statistics (2018), 75% of the population are Jews, 20% Arabs (Muslims and Christians), and 5% others. Among the Jews, 45% define their way of life as secular, 41% as traditional or religious, and 14% as Ultra-Orthodox. Among the Arabs, about 11% define their way of life as secular, 57% as traditional, and 31% define their way of life as very religious or religious.

To grasp the educational stakeholders' opinions, we conducted in-depth interviews with them, asking about possible tensions over theological components with respect to teaching and learning evolution. The research questions investigated in this study were

(i) What theological tensions do educational stakeholders see around evolutionary issues in Israeli society?

(ii) What methods of action do educational stakeholders propose to overcome or avoid possible tensions concerning evolution?

4 Methods

4.1 Research Design

This study was based on qualitative data gathered through in-depth interviews. The interview questions are presented in Appendix. Qualitative methods are suited to exploring issues that hold some complexity and to studying a process that occurs over time (Ritchie, 2003). The qualitative methodology used in this research was that of the 'multiple case study', in which several cases are examined to discover the similarities and differences between them (Baxter, & Jack, 2008). Our research was aimed at understanding the complex considerations of stakeholders related to the implementation of the new 2016 Israeli science and technology curriculum and biology curriculum, both of which include evolution. The similarities and differences between the different interviewees were revealed through the in-depth interviews, which allowed the interviewees to raise all of the topics that they deemed relevant, to explain their attitudes thoroughly, and to give concrete examples from the educational field.

The interview (Appendix) dealt with two main topics: (i) pedagogical considerations regarding the introduction of evolution in the junior-high-school science and technology curriculum or in the high-school biology curriculum (questions 1, 2, and 8) and (ii) possible tensions with respect to theological components related to this implementation (questions 3–7). In this article, we focus on the second topic.

4.2 Participants

Our study population was composed of 21 educational stakeholders (Table 1). Two of them were scientists consulting for the Ministry of Education (A), two were developers of teaching and learning materials (B), three were chief supervisors at the Ministry of Education at the time of the interview (C), four were former chief supervisors at the Ministry of Education (D), five were leading high-school biology teachers (E), and five were leading junior-high-school science teachers (F). The letters (A–F) and numbers (1–5) will be used to refer to the interviewees from each group (Table 1). The religious affiliation of the interviewees is listed in Tables 1, 2, 3, and 4, and when we refer to the interviewees in the Sect. 5: 'JNR' refers to Jewish non-religious interviewees, 'JR' is Jewish religious, and 'M' is Muslim.

We contacted the educational stakeholders related to the design of the science and technology curriculum and the biology curriculum in Israel, according to the official web page of the Pedagogical Secretariat at the Ministry of Education, by email. Some of the stakeholders were also included in the National Council for Science and Technology or for Biology. We interviewed 2 out of the 9 members of the junior-high-school science and technology National Council and 3 out of the 15 members of the high-school biology National Council at the time of the implementation of evolution into the curricula. It should be mentioned, that in Israel, the National Council advices the chief supervisors as for implementations into the curriculum; yet, the chief supervisors are the ones that have the authority to decide whether they accept these recommendations. We interviewed the present chief supervisors as well as the former ones at the time of the change in the curriculum. In addition, we interviewed the chief officer that was in charge of the chief supervisors at that time. We asked the stakeholders if they were willing to be interviewed for our research. All of them were willing, although two of them admitted that they had not been involved in the 2016 curricula. We arranged a meeting for an in-depth interview, lasting approximately an hour and a half each, with the other 11 stakeholders. Those

Table 1 Participants in semi-structured interviews

Affiliation of educational stakeholders	Number of interviewees	Religious affiliation	Letters and numbers used when referring to interviewees
Scientists consulting for the Ministry of Education	2	2 JNR	A (1,2)
Developers of teaching and learning materials	2	1 JNR 1 JR	B (1,2)
Current chief supervisors at the Ministry of education	3	2 JNR 1 M	C (1–3)
Former chief supervisors at the Ministry of Education	4	2 JNR 2 JR	D (1–4)
Leading high-school biology teachers	5	3 JNR 1 JR 1 M	E (1–5)
Leading junior-high-school science teachers	5	2 JNR 2 JR 1 M	F (1–5)
Total	21		

JNR Jewish non-religious, *JR* Jewish religious, *M* Muslim

who were concurrently working at the Israeli Ministry of Education asked to read their interview prior to its publication. We sent them the sentences that were to appear in this manuscript from their interview for approval. Sentences that the interviewees did not want published were omitted. Out of all interviews, this was the case for only two sentences, which the interviewees thought might be interpreted as going against the policy of the Ministry of Education.

The teachers ($n = 10$) were interviewed in two focus groups with which we arranged an hour and a half meeting. Each focus group consisted of five teachers with at least 10 years of teaching experience. These teachers came from a variety of places and sectors throughout Israel (see Table 1). As such, they were well aware of problems or protests that might arise in their communities. All of them were also part of a professional learning community of leading teachers. This means that in addition to being teachers, they are also leaders of a community of 20–25 teachers who meet on a monthly basis. These 10 leading teachers therefore reflect the situation among at least 200 teachers, each teaching a few classes of at least 30 students each. Thus, our sample effectively makes contact with more than 6000 students a year, and our small study has the ability to reflect a large population in Israel.

4.3 Data Analysis

The analysis was conducted in stages. We tape-recorded the interviews, and then transcribed them verbatim. As a first stage, we conducted a 'thematic analysis' (Boyatis, 1998; Dey, 1999) to obtain the main themes emerging from the interviews. The second stage was to obtain the codes from the thematic analysis. This was done according to 'grounded theory' analysis (Basit, 2003; Corbin & Strauss, 2008; Glaser & Strauss, 1967), by coding the replies until saturation. It should be mentioned that in contrast to questions 1–6 (see Appendix) that are not explicit and can lead the interviewee to a variety of answers, questions 7 and 8 are explicit and directed the interviewees to speak about "teacher training" and about "separation of religion and science", which were essential themes for our research. The third stage was a reflective process. After we had conducted a few interviews, we came to see some of the codes

differently, and we realized that some categories should be added. This was followed by a peer and auditor debriefing. Peers that were involved in the research and external researchers validated the codes (Creswell & Miller, 2000). Based on this validation process, the codes were refined again in the fourth stage, and the final categories were produced.

In accordance with the qualitative grounded theory approach, our goal was to enable the respondents' voices to be heard (Kvale, 1994) and not to force our preexisting categories. After listening to and transcribing the interviews, we conducted a detailed (line-by-line) micro analytical coding process to generate the categories upon which we had agreed (Devers and Frankel, 2000).

4.4 Validation and Reliability

During the data collection, we made an effort to maintain analysis reflexivity—to be as sensitive as possible to the ways in which we collected data and to minimize any bias due to prior assumptions or experience. As advised by Mays & Pope (2000), personal and intellectual biases were made plain at the outset of the research report to enhance the credibility of the findings. Since every researcher interprets the data according to his or her own subjective perspective, content validation was performed with the aid of four experts from different areas in the field of science education, all with extensive experience in qualitative analysis, so as to capture as wide a view as possible while defining the final codes (Elo & Kyngäs, 2008). In addition, as suggested by Graneheim & Lundman (2004), a dialog took place between the researchers to agree on how the data should be categorized. This procedure was performed twice, to ensure the accuracy of the categorization.

4.5 Evolution Curriculum: the Israeli Context

In the interview, we related to the topic of evolution in the Israeli junior-high-school science and technology curriculum and in the high-school biology curriculum. Both of these curricula have undergone recent changes. The change in the junior-high-school science and technology curriculum was initiated as a consequence of the results of international science exams in which Israeli junior high schools participated. These were not successful enough, with a lower average in the PISA exams (Programme for International Student Assessment) than the OECD average (The Organization for Economic Co-operation and Development). In 2012 the position of Israel was at the 40th place out of the 64 countries of the OECD (Israeli Ministry of Education, 2012). After a few years of participation in the international science exams, the Ministry of Education asked the science and technology chief supervisor to synchronize the Israeli junior-high-school science and technology curriculum with the framework of the international science exams. The National Council that was in charge of this work compared the Israeli science and technology curriculum with that of other countries that were successful on the international science exams and decided to make some changes in a few topics in the curriculum, including evolution. The changes were made with adaptations to Israel's needs and were approved by the Ministry of Education.

The biology changes in the science and technology curriculum were set with the supervision of the high-school biology studies. At the same time, the National Council of high-school biology studies recognized that the ground was also in place to make a change in the high-school biology curriculum, by implementing evolution into the main part of the curriculum as an obligatory topic. In addition, as an optional topic, the council realized that less than 5% of

biology students study evolution. Both of these considerations led to the change in the high-school biology curriculum.

4.5.1 Israeli Junior-High-School Science and Technology Curriculum

In prior Israeli junior-high-school science and technology curricula, the term evolution was not explicitly mentioned. In the 1990 biology curriculum, relevant to grades 7 through 12 (Ministry of Education, 1990), evolution was mentioned only in the 'core ideas' section:

> "According to current theories, the flora and fauna present in our world are the result of evolutionary processes."

In the 1996 science and technology curriculum (Ministry of Education, 1996), this sentence is mentioned in the appendix of the curriculum, after the details of all elective topics. It is only in 2016 that evolution became part of the junior-high-school science and technology curriculum (Ministry of Education, 2016b). The words 'evolution' and 'evolutionary processes' are mentioned 11 times in the curriculum, including in its main aims:

> "Students will understand that species diversity is the result of evolutionary processes."

4.5.2 Israeli High-School Biology Curriculum

In the prior high-school biology curricula (Ministry of Education, 1990, 2010), evolution was also mentioned only in the 'core ideas' section:

> "Evolutionary theory: The different species of living organisms change gradually over time due to changes in genetic information influenced by environmental factors and internal factors. According to the accepted explanation today, the genetic variability between individuals and the process of natural selection are the main factors for the existence of the vast diversity of creatures that lived in the past and those that exist today. The theory of evolution is the explanation for uniformity and modality."

In addition, in the 'core ideas' section of the 1990 high-school biology curriculum (Ministry of Education, 1990), special reference was made to the Jewish religious sector:

> "In addition to the regular terms, the religious school will also include developing the student's ability to stand cognitively and emotionally in the face of the 'contradictions' between science and religion by knowing the various answers accepted by believing Jews." (pp. 1-71)

Evolution was also studied as an elective topic in the biology curriculum in those years, but only a small percentage of the teachers chose to teach it; an average of less than 5% (4.46%) of the students studied evolution as an elective topic in the years 2011 to 2016.

Following the many years that evolution had been either an elective topic or placed in a very minor place in the biology curriculum, as of 2016 (Ministry of Education, 2016a), evolution was explicitly mentioned seven times in the main part of this curriculum. The curriculum states explicitly that greater weight be given to the evolutionary processes and to human intervention in these processes, and that "Evolutionary processes affect the prevalence of characteristics that characterize sex and species diversity."

In a review prepared for the Science Division of the Pedagogical Secretariat of the Israeli Ministry of Education by the ministry's acting Chief Scientist (Asher, 2015), the involvement of evolution in the revised Israeli junior-high-school science and technology and high-school biology curricula was compared to the situation in other countries. The review showed that the revised curriculum in junior high schools in Israel is similar in its attitude to evolution as that

of other countries that address this topic. Similar to nearly all other curricula in the world, in the Israeli curriculum, there is no reference to human evolution. Only two countries (Finland and Ukraine) make explicit reference to the origin of humans in the curriculum. Evolution is mentioned in the Israeli curriculum at the 8th grade level in the context of diversity, whereas for the 9th grade, the curriculum includes extensive emphasis on heredity, sexual reproduction, and evolution (Asher, 2015).

5 Results

This section is divided according to the category trees produced by our analysis of the stakeholders' interviews (Tables 2, 3, and 4). These trees summarize the main categories that emerged in the interviews, demonstrating the thoughts, tensions, and dilemmas raised from the educational field by the different educational stakeholders regarding the procedure of giving evolution a more significant place in the Israeli junior-high-school science and technology and high-school biology curricula. The left side of Tables 2, 3, and 4 shows the different categories, and the right side includes three columns reflecting the frequency with which these categories showed up in the interviews, as well as the religious affiliations of the interviewees mentioning

Table 2 Theological tensions surrounding evolution issues in Israeli society: categories relating to 'Opposition to teaching evolution'

	Number of quotations including this category	Number of non-teacher stakeholders relating to this category[a,c] and their religious affiliation		Number of teachers relating to this category[b,c] and their religious affiliation	
		Number of stakeholders	Religious affiliation[d]	Number of stakeholders	Religious affiliation[d]
(i) Feelings of discomfort because of religious belief	*13*	7/11	5 JNR 2 JR	*2/10*	1 JR 1 M
(ii) Objection because of rabbinic opinions	*3*	3/11	2 JNR 1 M	*0/10*	
(iii) Issues regarding Creationism vs. Darwinism	*12*	5/11	4 JNR 1 M	*2/10*	1 JNR 1 JR
(iv) Issues regarding the origin of man	*12*	3/11	1 JNR 1 JR 1 M	*1/10*	1 JNR
(v) Time dimension in the Bible vs. evolution	*2*	2/11	1 JNR 1 JR	*0/10*	
(vi) Resistance to accepting evolutionary principles	*7*	4/11	3 JNR 1 M	*0/10*	
(vii) Fear of presenting the topic	*4*	2/11	1 JNR 1 M	*0/10*	
Total	53				

JNR Jewish non-religious, *JR* Jewish religious, *M* Muslim

[a] The number of stakeholders who are not teachers and who related to this category in their interview

[b] The number of teachers who related to this category in their interview

[c] The total number of stakeholders who are non-teachers and teachers is lower in most cases than the number of quotations that were included in each category, since some of the interviewees related to several categories several times in their interview

Table 3 Theological tensions surrounding evolution issues in Israeli society: categories relating to 'Lack of opposition to teaching evolution'

	Number of quotations including this category	Number of non-teacher stakeholders relating to this category[a,c] and their religious affiliation		Number of teachers relating to this category[b,c] and their religious affiliation	
		Number of stakeholders	Religious affiliation[d]	Number of stakeholders	Religious affiliation[d]
(i) Not all religious sectors oppose evolution	6	5/11	4 JNR 1 JR	0/10	
(ii) Religious truth is different from scientific truth	6	3/11	1 JNR 2 JR	2/10	2 JNR
(iii) In the Bible, there is a different time scale	3	2/11	1 JNR 1 JR	0/10	
Total	15				

JNR Jewish non-religious, *JR* Jewish religious, *M* Muslim

[a] The number of stakeholders who are not teachers and who related to this category in their interview

[b] The number of teachers who related to this category in their interview

[c] The total number of stakeholders who are non-teachers and teachers is lower in most cases than the number of quotations that were included in each category, since some of the interviewees related to several categories several times in their interview

Table 4 Theological tensions surrounding evolution issues in Israeli society: categories relating to 'Methods of action to overcome or avoid tension'

	Number of quotations including this category	Number of non-teacher stakeholders relating to this category[a,c] and their religious affiliation		Number of teachers relating to this category[b,c] and their religious affiliation	
		Number of stakeholders	Religious affiliation[d]	Number of stakeholders	Religious affiliation[d]
(a) Teacher level					
(i) Learning materials (including evidence)	10	7/11	5 JNR 1 JR 1 M	2/10	1 JNR 1 JR
(ii) Teacher training	9	4/11	3 JNR 1 JR	3/10	2 JNR 1 JR
(b) Student level					
(i) Using quotes from Jewish sources	4	3/11	2 JNR 1 JR		
(ii) Separation of religion and science	9	3/11	1 JNR 1 JR 1 M	2/10	1 JNR 1 JR
Total	13				
All total	32				

JNR Jewish non-religious, *JR* Jewish religious, *M* Muslim

[a] The number of stakeholders who are not teachers and who related to this category in their interview

[b] The number of teachers who related to this category in their interview

[c] The total number of stakeholders who are non-teachers and teachers is lower in most cases than the number of quotations that were included in each category, since some of the interviewees related to several categories several times in their interview

these categories. The first column, 'Number of quotations including this category' shows the number of times during the 21 interviews that this category showed up, sometimes more than once in a particular interview. The second column refers only to the 11 educational stakeholders who were interviewed separately for an hour and a half each, indicating the 'Number of non-teacher stakeholders relating to this category and their religious affiliation'. The third column 'Number of teachers relating to this category and their religious affiliation' refers only to the 10 teachers who were interviewed in the two focus groups.

The aim of this analysis was to examine which of the categories was dominant, namely mentioned most frequently, and how many mentioned it in their interview. These data enable understanding the emphases of the interviewees, the focus of the 'tension' and the 'methods of action' to dissipate it in their opinion. The diversity of the interviewed stakeholders can be appreciated by considering their religious affiliations (Tables 2, 3, and 4). Nearly all of the categories are mentioned by a variety of interviewees, regardless of their religious affiliation. Notably, the proportion of interviewees who consider themselves religious (JR) is similar to the proportion in Israeli society (see Table 1).

The main part of the interview related to the tensions that might arise while introducing evolution into the science and technology and biology curricula. Our focus was on the theological tensions, because Israel is a highly varied multicultural society in which opinions about evolution might differ strongly, and we were interested in focusing on the tensions that might be present in such a society.

Israel's multicultural society is composed of a majority Jewish population with four broad categories of religious affiliation: secular, semi-religious, or "traditional", National Religious and Ultra-Orthodox. In addition, there is a large non-Jewish population, including Christian and Muslim Arabs, Druze, and Bedouins. As such, we expected the interviewees to tell us about religious tensions while incorporating evolution into the science and technology and biology curricula. We heard about the theological tensions leading to "Opposition to teaching evolution" (Table 2), but we also heard the clear voice of "Lack of opposition to teaching evolution" (Table 3), especially from the secular and National Religious sectors.

5.1 Opposition to Teaching Evolution

Table 2 deals with 'Opposition to teaching evolution'. The opposition was divided into seven subcategories: (i) feelings of discomfort because of religious belief, (ii) objection because of rabbinic opinions, (iii) issues regarding Creationism vs. Darwinism, (iv) issues regarding the origin of man, (v) time dimension in the Bible vs. evolution, (vi) resistance to accepting evolutionary principles, and (vii) fear of presenting the topic. The first five categories relate to the religious aspect of opposition and the last two categories relate to the emotional aspect of resistance.

In subcategory (i), we heard about the strong discomfort of the Muslim sectors in both of the following representative quotations. The first addresses a situation in which a science teacher does not fully believe in the theory of evolution because of his or her religion:

> "The teacher will tell his students that evolution is in the curriculum and he is required by law to teach it, but according to his religion, it is forbidden to teach it. So what will he do? He will tell his students to learn, but not to believe in what he teaches. That is very bad. A teacher will say: 'I understand this is the curriculum, this is biology and this is science, but I cannot teach it'." (C1, M)

This quotation reflects the teacher's dilemma in teaching evolution. Even if he/she realizes the importance of the scientific topic, there is a problem teaching it because of his/her religious beliefs. The next quotation shows feelings of discomfort due to students' tension:

> "If the teacher is not from the Islamic Movement but from another stream, then he does not have a problem teaching this topic, he will teach about Darwin and so on. But there have been cases in which students objected, complained. Their parents came and asked, 'Why are you teaching our children such things? Why was he teaching Darwin's theory?'." (C1, M)

This quotation refers to religious opposition in the Muslim sectors, where even if the teacher is willing to teach the scientific facts, the parents oppose their children's receiving this content knowledge.

> We heard the voice of 'Feelings of discomfort because of religious belief' in the Jewish sector as well, showing that religious beliefs can be an obstacle to using learning materials that pertain to evolution:
>
> "When a textbook about evolution was written, I really wanted the religious sector to be able to use it…I care that the religious sector be able to hold on to this book." (B2, JR)

The theme 'Feelings of discomfort because of religious belief' was mentioned 13 times during the interviews, by 9 different interviewees, showing that it is a dominant topic that bothers many of them.

Religious opposition was also related to 'Objection because of rabbinic opinions'. A representative statement reflecting this was:

> "…Do not forget that some of the objections to evolution come from influencing factors. Let's say that if rabbis say it, then people will be influenced…We see that there is no correlation between a person's broad education on this subject and the acceptance of evolution because of such influences." (D2, JNR)

The influence of rabbis on religious sectors is vast. Religious people follow their rabbinical authority even though they are more scientifically educated than the rabbi, since this authority is a binding one for some religious people. This category was mentioned much less, by only three stakeholders, showing that even though religion is an important part of the tensions, the rabbi's influence is much less prominent.

'Issues regarding Creationism vs. Darwinism' was another common subcategory in the opposition to teaching evolution, mentioned 12 times by seven interviewees, 5 of them non-teacher stakeholders. For instance:

> "It is probably something they [the students] heard at home, they did not invent it themselves, they heard the concept that evolution contradicts creationism and they brought it to classroom." (E3, JNR)

This means that some of the opposition to evolution stems from the clash between Creationism and Darwinism, which is a typical theme for religious people. These people believe that the creation of the world took a certain defined period of time whereas according to scientists, the world is still undergoing selection and evolution.

'Issues regarding the origin of man' were very commonly spoken about as controversial:

"What oppositions do I hear? God is the one who did everything and there are no processes. Everything is created as is. Of course the origin of man has quite a few objections, but I am dealing with them as well as I can." (E1, JR)

The origin of man is a provocative topic of discussion that science teachers find difficult to deal with. An interesting finding is that this theme is mentioned 12 times but by only four interviewees, meaning that it troubles a relatively low percentage of the stakeholders, while those who did find it to be a problematic issue spoke about it several times.

The following quotation addresses the 'Time dimension in the Bible vs. evolution' subcategory:

> "Due to the Hebrew calendar, the Ultra-Orthodox insist that the world has existed for 5,000 years...the Ultra-Orthodox Jews did not teach evolution even though it was in the curriculum." (D4, JR)

The age of the world is a controversial topic leading to opposition to teaching evolution, especially in the Ultra-Orthodox sector; however, since the interviewed stakeholders did not belong to this religious sector, this theme was only mentioned twice, by two different stakeholders.

The last two categories that relate to the emotional aspect of resistance were less dominant, being mentioned a total of 11 times for both subcategories: (vi) resistance to accepting evolutionary principles and (vii) fear of presenting the topic. Nevertheless, this theme is an important one, showing that tensions leading to opposition to teaching evolution stem not only from a religious perspective but also from an emotional one.

'Resistance to accepting evolutionary principles' was raised seven times by four different interviewees, indicating that this theme truly worries them. For example:

> "It's not just a matter of being religious or secular; I think it's something like a mascot which is a bit difficult to accept. I think it's something emotional. There are students that even if we teach them, they will not accept it and it is not related to understanding or knowledge. It's something emotional." (D3, JNR)

This quotation places the topic of evolution in a different context, not problematic because it is controversial, but provoking antagonism because of its emotional connotations.

The following quotations reflect the fear of teaching evolution because of its consequences—becoming faithless and touching on the origin of man:

> "They are afraid that as soon as the child believes in Darwin he will become faithless." (C1, M), and "The fear of the religious sector was that if we teach evolution, students will relate what we teach to the origin of man." (D4, JR)

This category was not a prominent one; it was only mentioned four times by two stakeholders in terms of fear, but we felt that it was strong enough to be given a separate category. It should be noted that none of the teachers spoke about 'Fear of presenting the topic' (see Table 2) which addresses the fear that the non-teacher stakeholders spoke about. It could be that the latter find the situation more "frightening" than the teachers think it actually is in the classroom.

5.2 Lack of Opposition to Teaching Evolution

Happily, interviewees spoke not only about the opposition to teaching evolution but also about the absence of such opposition (Table 3). This perspective included three subcategories: (i) not all religious sectors oppose evolution, (ii) religious truth is different from scientific truth, and (iii) in the Bible, there is a different time scale. It seems here that the introduction of evolution into the 2016 curriculum did not raise any conflicts among the interviewees. On the contrary, the supervisors from the Ministry of Education received support from most sectors, except the Ultra-Orthodox one, when writing the revised curriculum. Although the interviewees spoke about a lack of opposition to teaching evolution, we can clearly see in Table 3 that the frequency of these categories was much lower (15 quotes) than that of categories dealing with

opposition to teaching evolution (Table 2, 53 quotes). This implies that even though a lack of tension was mentioned in the interviews, tensions and opposition were still much more dominant than the acceptance of evolution.

The following quotation reflected subcategory (i):

> "We have even received support from the (Jewish) religious public because...let's admit it, they do not want to be in a dark world." (D3, JR)

This statement of evolution not always raising conflicts, but on the contrary, being accepted by many sectors, was further reinforced by one of the former chief supervisors at the Ministry of Education who assumed that all sectors of our society understand the importance of teaching evolution:

> "The field was quiet. I will tell you why. It was quiet because I do not think it was such a problem, not even for the religious...and we have to teach it in such a way that even in religious (Jewish) sectors it will pass quietly. I do not think anyone has an argument regarding evolution in the context of ecology." (D4, JR)

Both of these quotations show us that among certain Jewish religious sectors, there is no antagonism, meaning that only some of the religious sectors or some of the individuals in those religious sectors are antagonistic to teaching or learning evolution. This subcategory was mentioned six times by five different interviewees and was thus less dominant than those dealing with opposition to the teaching of evolution (Table 2); nevertheless, it was certainly mentioned.

Subcategory (ii), 'Religious truth is different from scientific truth', dealt with the difference between religious and scientific certainty:

> "The difference between a scientific theory and a religious belief is that in a scientific theory, the truth is a relative truth. It is correct as long as it is not proven otherwise. Religious truth is absolute truth and therefore, there is no point in comparing them. We cannot compare these categories…We are not trying to prove science by religion or religion by science because they have no relevance to each other. Faith is something irrational. It is impossible to prove that one has to believe, whereas science is rational." (D1, JR)

This quotation demonstrates that according to some Israeli Jewish sectors, scientific truth does not oppose religious truth since they are two different disciplines. This might be due to the fact that some religious sectors realize that the Bible is neither an informative book nor a history book, and this theme was therefore even reflected by the religious interviewees. Of our stakeholders, five spoke about this theme, two of them teachers. Some of the interviewees were even angry when relating to the Bible as an informative book:

> "I cannot stand it that people give evidence from the Torah for evolution. To make the Torah a book of information?" (D1, JR)

The fact that some people relate to the Bible as a history book bothers these people, allowing them to look at the scientific evidence in a completely different way from religious beliefs and to separate them.

In the subcategory 'In the Bible there is a different time scale', stakeholders emphasized that, in addition to the fact that science and religion should be separated, their time scales differ:

> "I think that most students understand that there is a different time scale for the creation of the world, even religious students." (D3, JR)

The issue of time scale in the Bible compared to that of evolutionary theory is known to be controversial. This category further highlights the lack of opposition to teaching evolution by three stakeholders relating to it.

It should be noted that only a few teachers related to the three categories dealing with 'Lack of opposition to teaching evolution' (Table 3). This might be because we had a rather small sample of teachers and they did not raise this topic, but it might also be that the teachers did not feel that lack of opposition to teaching evolution is strong enough to be discussed.

We demonstrated that evolution is a problematic issue for some individuals and some sectors in Israel's multicultural society. Still, there was no revolt when evolution was introduced into the 2016 curriculum. This contradiction led us to our last topic of the interview, i.e., methods and approaches used by curriculum designers to overcome or avoid the tensions surrounding evolution.

5.3 Methods of Action to Overcome or Avoid Tension

Our second research question related to the methods suggested by stakeholders to overcome or avoid the tension surrounding evolution (Table 4). The methods proposed by the stakeholders fell into two categories: 'Teacher level' and 'Student level'.

5.3.1 Teacher Level

Teachers play an important role in the way the topic of evolution is introduced to their students. They therefore need appropriate learning materials and much scientific knowledge to teach the topic of evolution with as little tension as possible.

The subcategory of 'Learning materials' emphasizes the importance of these materials in helping teachers teach a topic that many of them are not comfortable with.

> "In the scientific sphere, everything has to be factually based. What has no basis of evidence does not exist. That's how I would teach it." (B1, JNR)

> "I would write the topic of evolution as a kind of puzzle, with discovery and traces and evidence, and it could be so fascinating. Because you can see the traces of the dinosaurs and you can see fossils. You can talk about everything. The evolution of physiology, the evolution of the heart. It means that you're looking. All of the comparative biology can be taught here. You can teach skills, observations, experiments, everything that can be done around evolution so that through it, the core ideas will be taught. I would not miss anything, on the contrary, I would pad the story so that it will have enough content to give the child insights into the essence of science." (C2, JNR)

Both of these quotations show us the importance of introducing evidence of evolution to students as part of the learning materials and as a way of avoiding tension. This category was mentioned by nine different interviewees in 10 quotations. Another subcategory mentioned nine times, 'Teacher training', related to the appropriate teacher training that might overcome or avoid tension.

> "I think we should have given the teachers tools as well, and I think that in the first two years of the new program, we really devoted our teacher-training courses to evolution to give the teachers these tools." (D2, JNR)

> "Because, in all, this is a controversial subject...I think it's done with a lot of sensitivity. Not with power. Gradually, teacher-training courses were opened and teachers could register, no one forced teachers to register. It was not done in a forceful way, so I did not get any complaints. I felt as an instructor that I had to stand by the teachers and give them tools so that they could face students who asked." (D3, JR)

Stakeholders admitted that an outcome of teacher training might be that teachers will gain more confidence in the subject matter, and this might lead to students feeling more comfortable with the topic. As a consequence, clashes between students' prior ideas and scientific facts can be reduced so long as there is respect for all opinions:

> "You also have to respect the feelings of others, what they believe. I think if you present the topic objectively, in the form of something open, of asking questions, telling the students: 'I do not want to tell you, I want us to think together'. I think that in the end maybe they will remain with their previous ideas that all is by God but it gives them another way of thinking." (C1, M)

A total of 19 quotations related to methods of action at the teacher level, and 13 at the student level, showed us that most stakeholders think that it is extremely important to train the teachers and enable them to be comfortable with the topic of evolution.

5.3.2 Student Level

Two categories were mentioned for this level: (i) using quotes from Jewish sources and (ii) separation of religion and science. These methods of action involve teaching in a way that will use the religious texts and religious standards as aids for overcoming tension. The stakeholders explicitly stated that these actions might facilitate the acceptance of evolution and elicit less tension regarding evolution teaching.

One of the ways to avoid tension is thus by exposing teachers and students to the ideas of religious philosophers who deal with the philosophy of creation.

> "In order to deal with evolution in the religious (Jewish) sector, one can present the view of Rabbi Kook or others." (B2, JR)

By using quotes from Jewish sources, in addition to understanding the scientific evidence, tensions in learning evolution can be minimized. If teachers will first understand the Jewish sources dealing with the conflict, they will be able to offer their students reliable answers regarding religious ideas, resulting in much less antagonism toward studying these topics.

> "I gave lectures on teaching evolution without hurting faith. It was important to me that even secular teachers would know these things, so that they would know that it was not some religious nonsense. This has philosophical significance throughout the generations and we must understand how to deal with it—how a religious Jew should handle it. Even if they are non-religious teachers, they should know this." (D1, JR)

The tensions and antagonism toward teaching and learning evolution do not only exist in the Jewish religious sector; therefore, all sectors should be in a position of being able to answer theological questions if they arise in their classroom.

In addition, a clear voice was heard in nine statements by five different stakeholders, two of them teachers, calling for a clear separation between science and religion, since they are different domains with different languages and terminologies. For example:

> "In my view, absolute separation must be achieved. It must be very clear that religion belongs to the spiritual world...In my eyes, faith and science cannot live in the same place, but you have to recognize that there is room for this and there is room for that, for those who believe religion exists and live in peace with both." (B1, JNR)

> "I think evolution is a scientific discipline and it has its methods of learning; religion is a religious discipline. I do not see the Torah as a history book, a biology book or a geography book. It is a book of Halacha and faith. By the same token, I do not see science as a book of Halacha." (D1, JR)

Both of these quotes show that faith might be separated from science, and thus, each discipline can be learned and taught using its relevant tools. The quotes reveal a recommendation for this separation, so that evolution will not raise tensions among students and their teachers. The teachers also mentioned these methods of action (Table 4), yet a relatively low percentage of them spoke about these themes, maybe since as teachers they are more concerned with teaching the scientific knowledge and less concerned with avoiding tensions.

In addition to the tensions raised by the stakeholders, we also heard about difficulties, such as those relating to evolution as a topic that is hard to teach since many teachers do not fully understand it. This and other difficulties are universal and do not relate specifically to Israel's multicultural society. Therefore, we did not focus on them and we do not relate to them in this article.

6 Discussion

The goal of this study was to probe the insights of Israeli educational stakeholders regarding the revision of the Israeli science and technology and biology curricula with respect to the topic of evolution. Our study was designed to capture the educational stakeholders' opinions regarding the theological tensions surrounding the incorporation of evolution in these curricula, as well as methods of action to overcome or avoid these possible tensions. To capture these opinions, we conducted in-depth interviews that gave a complex picture of different ideas and approaches, while describing a fairly uniform line regarding the basic tensions and methods of action. Our main findings were that religious opposition to evolution exists in the Jewish as well as Muslim sectors. Opposition exists especially in the areas of 'the origin of man' and 'the age of the world'; yet not only religious, but also emotional resistance (Thagard & Findlay, 2010) leads to opposition to teaching and learning about evolution. We found lack of opposition to be quite common among several Jewish religious sectors, resulting from the separation of faith and religion from evolution. Lack of opposition has also been found in other Jewish religious societies, such as in South Africa, where only 2 of 32 students participating in a study thought that one cannot believe in evolution if you believe in God (Kagan & Sanders, 2013). The interviewees in our research claimed that to avoid theological tensions, teacher training, as well as appropriate learning materials, are needed to provide the teachers with scientific knowledge, along with tools for understanding spiritual texts that raise the tension between religion and evolution. If the teachers are able to deal with this conflict, their students will be able to deal with it with much less controversy.

In Israel, teachers usually teach at schools in the sector to which they also belong. Jewish religious teachers teach at religious schools, Muslim teachers teach at Muslim schools, etc. According to the Central Bureau of Statistics (2018), only 2.3% of Muslim teachers teach in the Jewish secular sector. In light of this information, we might think that the controversy would be less prominent, as there is a cultural match between teachers and students; however, this is not the case.

Since the controversy still exists in many sectors, the interviewed teachers and the other educational stakeholders stated that some teachers teach evolution because it is part of the curriculum and not because it is an essential part of biology. Previous research has also found this situation among preservice science teachers (Dotger, Dotger, & Tillotson, 2010). This shows that evolution is a field in need of a different approach and special sensitivity, since the tensions surrounding it make it a topic that is not obvious for biology teachers to teach. Hence,

Hildebrand, Bilica, & Capps (2008) identified four types of instructional approaches: (i) avoidance approaches, such as omitting evolution from the biology curriculum or teaching only the non-controversial topics within evolution; (ii) corrosive approaches, in which teachers tell students that they do not have to "believe" evolution and thus deny the existence of the controversy entirely (Berkman & Plutzer 2011); (iii) teaching about controversy, an approach intended to engage students to face their personal feelings, thoughts, and beliefs in relation to the controversy associated with biological evolution; (iv) proactive, prosocial approaches that acknowledge the social controversy as part of the curricular and instructional planning, but do not actually teach the controversy as part of the classroom experience. Instead, the teacher designs the curriculum so that it focuses on the special qualities of science in a manner that helps students distinguish between scientific and non-scientific methods of inquiry and questioning. This approach encourages an ongoing, long-term distinction between natural and supernatural explanations.

It is not rare to find teachers in the US who emphasize only microevolution in teaching evolution, justifying the teaching of the topic on the basis of statewide tests or "teaching the controversy" while weakening the legitimacy of scientific findings. These teachers fail to explain the nature of scientific inquiry and legitimize creationist arguments, albeit unintentionally (Berkman & Plutzer 2011). This approach also exists in Israel, for example, where some of the interviewees spoke about teaching evolution only because it is part of the state curriculum or teaching it without fully understanding it. This approach opposes that of Pennock (2002), which does not allow the evolution conflict into the classroom and further, does not allow teaching creationism in the science class at all. Pennock (2002) goes further by claiming that questions of the existence, or possible activities of the Creator should not to be found in the scientific literature and might be mentioned in science textbooks only as a historical comment about hypotheses that have been refuted.

On the other hand, other interviewees mentioned the importance of dealing with quotes from Jewish sources, and the importance of speaking about separation of religion and science, which seems to be a combination of the third and fourth approaches suggested by Hildebrand et al. (2008). They explicitly mentioned the importance of facing the different approaches to evolution as a way of dealing with the controversy and as a way of enabling the different voices to be heard, thereby lessening the antagonism to evolution. This approach is similar to the culturally competent teaching described by Barnes & Brownell (2017), which is a method to help instructors reduce students' perceived conflict between evolution and religion. Although the stakeholders did not explicitly mention this term, the characteristics of culturally competent teaching match the methods of action to which the stakeholders referred.

As indicated by the educational stakeholders, teachers should use quotes from Jewish sources to teach with less resistance. Barnes, Elser & Brownell (2017) suggested that teachers show their students different positions on the relationship between religion and evolution and distinguish which of these positions are philosophically compatible with the evidence from science, and which are not. Both the stakeholders and Barnes et al. (2017) speak of the same type of teaching—that which does not ignore religion or religious philosophers who are not compatible with evolution. We are aware of the fact that this might be problematic because many science teachers do not have the necessary background to deal with theological questions and concepts (Dodick et al., 2010).

One of the categories mentioned as raising tensions in the interviews was the fact that the time dimension in the Bible might contradict the evidence of evolution. This tension has been pointed out in the context of culturally competent teaching. The suggestion for not raising

tension in this field is to not interpret certain parts of the Bible literally, similar to many religious leaders and scientists, leading to less rejection of evolution (Martin-hansen, 2008). Once again, we perceive that discussing different perspectives of the topic leads to less conflicts and allows religious beliefs to coexist with the concept of evolution.

The stakeholders who participated in this study also pointed out methods of action to overcome theological tensions. They spoke about the need for learning materials that include evidence, and teacher training that includes the scientific facts for better introduction of the topic; the option of quoting religious sources that show that religious authorities also accept evolution; and the separation of religion and science. Barnes & Brownell (2018) found that teachers regularly use culturally competent practices to reduce students' dissonance between religion and evolution and increase their acceptance of evolution. In addition, the teachers in the Barnes and Brownell study (2018) reported that when they themselves learned evolution, they had a negative experience in the absence of culturally competent instruction. Recent research regarding ways to reduce the dissonance between religion and evolution (Truong et al., 2018) has reported that teaching about the potential compatibility of evolution and religion can positively affect biology undergraduate students who perceive a dissonance between their religious beliefs and evolution. Students in Truong's study (2018) mentioned a few aspects that reduced their levels of dissonance: the fact that teachers did not force students' acceptance of evolution, and were respectful of multiple viewpoints regarding evolution; their increased exposure to evolution content including evidence, and their instructors mentioning religious scientists who have come to terms with their religious beliefs and evolution; the instructors facing the fact that in some students, there is a dissonance between religion and evolution; the instructors teaching them that science and religion can be conceptualized as two separate realms; and finally, that students felt that they could safely voice their opinion of evolution in the classroom (Truong et al., 2018). All of these aspects introduce us to specific ways of culturally competent teaching that enable decreasing tensions without giving up on teaching all of the essential components of evolution. Some of these methods of action were introduced by the educational stakeholders, such as introducing teachers to learning materials that include evidence. Other aspects mentioned by Truong et al. (2018) might be a basis for future research.

An additional tool for teaching and learning religiously 'controversial' science topics is constructed as a learning cycle, enabling students to reflect on their response to the issues being discussed, then use their personal experiences to engage with specific issues, and finally develop critical filters to inform their personal perspective, at which point the whole cycle starts again (Stolberg, 2010). The advantage of this tool is that each student is able to raise his or her own perspective and elaborate it without feeling that a particular opinion is not legitimate. This tool constitutes a response to the emotional resistance that the interviewees spoke about and might decrease the tension raised by evolution.

Another approach to reaching the goal of accepting evolution with as little tension as possible was introduced by Smith and Siegel (2016): the student gains evolution knowledge upon which he or she can build understanding. As understanding is achieved, the student hopefully comes to see the value in accepting the fact that evolution adequately describes biodiversity, etc., is ready for decision-making, and decides to accept evolution. Based on understanding and accepting evolution, the student finds that he or she is willing to feel that evolution is the best scientific explanation for the relevant biological phenomena and thus that evolution is true (Smith & Siegel 2016). This possible path may lead to an acceptance of evolution that is based on knowledge with minor tension. Yet students may find that

acceptance and belief in the truth of evolution theory require a change in their basic perspective, and that it is impossible for them to believe that evolutionary theory is true (Smith, 2010).

For a student to gain understanding, knowledge and acceptance of evolution, the teacher must have full content knowledge (Cavallo, Mccall, & Mccall 2014). As we mentioned, the stakeholders who participated in this study related to the issue of content knowledge mainly in the categories dealing with avoiding tension. They emphasized adequate teacher training as a requisite for minimizing dissonance. Not all teachers receive the needed training, and misconceptions have been observed among non-biology teachers, and even among biology teachers (Nehm, Kim, & Sheppard 2009). Both groups of teachers showed a preference for teaching creationism (Nehm et al., 2009). For that reason, avoiding tension is essential, as the stakeholders reflected, via teacher training that includes evolutionary evidence as well as adequate learning materials.

Culturally competent teaching has been previously addressed, not only with respect to evolution. Preservice teachers have understood that students are connected to a complex social and cultural network that has an influence on their educational growth. When a teacher can recognize and benefit from his or her students' background, the learning and teaching processes are positively influenced (Barnes 2006). Supporting research dealing with multicultural societies around the world showed that these societies have many characteristics in common, such as multicultural education, attitudes toward multiculturalism, and even multicultural identity (Arasaratnam, 2013). This enforces the fact that cultural competence is relevant not only with respect to the teaching of evolution, but also to the teaching of topics such as genetic counseling, in which a culturally competent approach is needed to reach informed decisions (Siani & Ben-Zvi, 2017). In the field of evolution teaching and learning, a culturally competent approach is needed to make the decision to teach and learn without antagonism and without delegitimizing the topic.

Finally, the stakeholders voiced some considerations that should be taken into account when introducing evolution into the curriculum, with the aim of raising as little dissonance as possible and without stirring up a public storm. The educational stakeholders succeeded in this endeavor, and the topic of evolution was accepted by most of the Israeli sectors, who teach, at least partially, the less problematic topics of evolution that have been selected for inclusion in the curriculum.

7 Limitations

An obvious limitation of our study is the small number of participating interviewees. Had the number of stakeholders been larger, we would have heard more opinions relating to teaching without raising dissonance, more about theological tensions, and more methods of action to overcome or avoid the tension surrounding evolution. The data in Tables 3 and 4 illustrate the limitations of the small sample of teachers, where we see that there are categories that no teachers addressed. Nevertheless, in Israel, the curricula are centrally written and are obligatory for all sectors; as such, they do not involve many stakeholders. We did interview the stakeholders of the Ministry of Education who were associated with the science and technology and biology curricula at the time of the change.

Another limitation of our study is that we did not interview students; this might have added the perspective of 'learned' curriculum, i.e., the curriculum as experienced by the students (Glatthorn et al., 2018). On the other hand, we could not be sure of the reliability of their

answers (Goodlad 1979), and we therefore chose not to add this angle to our research so as not to bias our results or shift the focus to other aspects that were not raised by the educational stakeholders.

An additional limitation is that some of the teachers' answers might have been designed to please us, or they may not have wanted to admit that they have a problem, or feel uneasy teaching evolution, as this might be perceived as a weakness.

In addition, it should be noted that we cannot generalize our findings to the whole of Israeli society due to its very diverse and multicultural nature, with diversity among teachers in terms of residential areas, socioeconomic levels, and cultural/religious backgrounds. Our small sample of teachers is too small to generalize, even though we chose teachers who are leaders in their communities and thus mentors for groups of other teachers. Furthermore, the relatively small size sample of the educational stakeholders who are not teachers limits the possibility for generalization, even though in a small country such as Israel there is a relatively small group of people who are in charge of curriculum change and in this small group the authority for decisions on curriculum changes is vested to the chief supervisors who we interviewed.

8 Recommendations and Further Research

This study has some implications, both at the practical level of teaching biology in high school and junior high school, and at the science education research level. From the practical point of view, the results of this study enable to draw several conclusions about the implementation of evolution in the curricula. In fact, 2016 was the first time in Israel's history that evolution was formally and explicitly implemented into the science and biology curricula as a mandatory topic. In general, we can conclude that this implementation was not accompanied by widespread protest and was, in fact, accepted relatively quietly. Thus, this implementation may place the teaching and learning of evolution in Israel in a new light, affording the ability to speak about it with less fear in most sectors. In addition, this research might inspire researchers and teachers outside of Israel whose curricula do not include evolution explicitly as a mandatory topic to try and achieve its inclusion with less fear of resistance. From the theoretical perspective of science education research, this paper may possibly increase our understanding of the interaction between the scientific discourse associated with evolution, and the alternative discourses that the educational stakeholders brought to the interviews. Finally, it sheds some light on the pedagogies that might be used to write evolution intervention programs taking into account the stakeholders' suggested ways of overcoming or avoiding tension.

Further research is needed to supplement our findings. One important finding is that to promote evolution acceptance and to lower tensions, stakeholders encourage culturally competent evolution teaching and learning. Another finding is that the teaching and learning of evolution should be evidence-based. Considering these findings, we suggest to investigate the use of a teaching and learning model, which will be based on two learning environments: in a science museum and in school. The suggested model is grounded in the cultural competence theory (Brown 2017) that was adapted to evolution education (Barnes & Brownell 2017), as well as in evidence-based argumentation (McNeill & Berland 2017) The model shall include hands-on visits to a natural history museum, such as the SMNH (The Steinhardt Museum of Natural History, 2019), for 'science days' each of which will be accompanied with a

corresponding complementary unit at school. The complementary school unit will be devoted to elaborating, contextualizing and addressing the evolution theory.

Another important finding of this research is that for successful learning of evolution, science and religion should be separated. This paper focuses on educational stakeholders in Israel, which is a small country; despite being a multicultural society, it does not represent all countries. We know that in other countries, the situation regarding the relationship between science and religion, especially as related to evolution, can differ (Athanasiou, Katakos, & Papadopoulou 2016; Clément, 2015; Eder et al., 2018; Sanders, 2018; Yok et al., 2015). Broader research with a large sample of international stakeholders will expand the scope, enabling us to draw conclusions about curriculum implementation and about developing intervention activities tailored to students of different cultures and nationalities.

As the focus of this study was the Israeli science and technology curriculum for junior high school and the biology curriculum for high school, we asked the stakeholders about the implementation of the curricula in the classroom. These categories are not included in the results section because we decided to concentrate, in this article, on tensions and possible ways to avoid them. Nevertheless, it is important to note that a few of the stakeholders, including many of the teachers, stated that when there are questions on the national exams regarding a certain topic, it will be taught in class. Otherwise, it will not be taught. High-school teachers stated that since 2016, when the biology curriculum was revised and evolution was explicitly introduced, biology matriculation exams began including questions on evolution. High-school biology teachers therefore began teaching this topic, regardless of their or their students' tensions, and despite all of the difficulties. In contrast, in junior high schools, even though the topic was introduced into the curriculum at the same time, there have not yet been any questions on the national exams dealing with evolution and teachers do not teach this topic, even claiming that it is not in the curriculum at all. This situation is not new; Glatthorn et al. (2018) found that the written 'recommended' curriculum is not the same as the 'taught' curriculum. In places where there is no enforcement of the curriculum on national exams, the 'recommended' curriculum is not implemented. We therefore recommend that the supervision of science teaching include questions regarding evolution on the national exams, so that teachers will teach the topic at all levels.

Compliance with ethical standards

Conflict of Interest The authors declare that they have no conflict of interest.

Appendix

Interview questions

i. When was the topic of evolution added to the science/biology curriculum
ii. What were the motives to add the topic "evolutionary processes" to the junior-high science and technology/high-school biology curricula?
iii. Were there any considerations against introducing these contents into the curriculum?
iv. Students from Ultra-Orthodox schools are also enrolled in the matriculation exams in biology. Did the introduction of this topic raise questions about the acceptance of the curriculum in a heterogeneous class that includes students from the Ultra-Orthodox sector?

v. Have there been issues in evolution that you deemed inappropriate for inclusion in the core subjects of the biology/science curriculum?
vi. Have there been appeals from various sectors of Israeli society to the Ministry of Education regarding the introduction of these contents into the curriculum?
vii. Do you think religion and evolution should be taught as two separate disciplines or as complementary theories?
viii. What are the main messages that need to be passed along in a teacher-training course on evolution?

References

Allgaier, J. (2010). Scientific experts and the controversy about teaching creation/evolution in the UK Press. *Science & Education, 19*(6–8), 797–819. https://doi.org/10.1007/s11191-009-9195-5.

Arasaratnam, L. A. (2013). A review of articles on multiculturalism in 35 years of IJIR. *International Journal of Intercultural Relations, 37*(6), 676–685. https://doi.org/10.1016/J.IJINTREL.2013.09.006.

Asher I. (2015). Teaching evolution in the official curriculum in Israel and around the world. Retrieved April 30, 2019, from http://meyda.education.gov.il/files/Scientist/evolution.pdf

Athanasiou, K., Katakos, E., & Papadopoulou, P. (2016). Acceptance of evolution as one of the factors structuring the conceptual ecology of the evolution theory of Greek secondary school teachers. *Evolution: Education and Outreach, 9*(1), 7. https://doi.org/10.1186/s12052-016-0058-7.

Barnes, C. J. (2006). Preparing preservice teachers to teach in a culturally responsive way participants came from diverse backgrounds University participants. *The Negro Educational Review, 57*(1–2), 85–101.

Barnes, M. E., & Brownell, S. E. (2017). A call to use cultural competence when teaching evolution to religious college students: Introducing religious cultural competence in evolution education (ReCCEE). *CBE Life Sciences Education, 16*(4), 1–10. https://doi.org/10.1187/cbe.17-04-0062.

Barnes, M. E., & Brownell, S. E. (2018). Experiences and practices of evolution instructors at Christian universities that can inform culturally competent evolution education. *Science Education, 102*(1), 36–59. https://doi.org/10.1002/sce.21317.

Barnes, M. E., Elser, J., & Brownell, S. E. (2017). Impact of a short evolution module on students' perceived conflict between religion and evolution. *The American Biology Teacher, 79*(2), 104–111. https://doi.org/10.1525/abt.2017.79.2.104.

Basit, T. N. (2003). Manual or electronic? The role of coding in qualitative data analysis. *Educational Research, 45*(2), 143–154. https://doi.org/10.1080/0013188032000133548.

Baxter, P., & J. S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report, 13*(4), 544–559.

Berkman, M. B., & Plutzer, E. (2011). Defeating Creationism in the courtroom, but not in the classroom. *Science, 331*(6016), 404–405. https://doi.org/10.1126/science.1198902.

Berkman, M., & Plutzer, E. (2010). Evolution, Creationism, and the Battle to Control America's Classrooms. In *Cambridge University Press.*. Retrieved from https://books.google.co.il/books?hl=iw&lr=&id=caXjKtbWWK4C&oi=fnd&pg=PR5&dq=Evolution,+creationism,+and+the+battle+to+control+America'sclassrooms.+New+York:+Cambridge+University+Pres&ots=SYapZ-G7y_&sig=Kn6rrhuwqG7ZNdU12RwYchs7eRw&redir_esc=y#v=onepage&q=E

Birdthistle, N., Hynes, B., & Fleming, P. (2007). Enterprise education programmes in secondary schools in Ireland: a multi-stakeholder perspective. *Education + Training, 49*(4), 265–276. https://doi.org/10.1108/00400910710754426.

Blancke, S., Hjermitslev, H. H., Braeckman, J., & Kjærgaard, P. C. (2013). Creationism in Europe: facts, gaps, and prospects. *Journal of the American Academy of Religion, 81*(4), 996–1028. https://doi.org/10.1093/jaarel/lft034.

Boyatis, R. E. (1998). Transforming qualitative information: thematic analysis and code development.. Sage.

Brown, J. C. (2017). A metasynthesis of the complementarity of culturally responsive and inquiry-based science education in K-12 settings: implications for advancing equitable science teaching and learning. *Journal of Research in Science Teaching, 54*(9), 1143–1173. https://doi.org/10.1002/tea.21401.

BSCS Science learning. (2019). Retrieved May 1, 2019, from https://bscs.org/about/our-story/

Cavallo, A. M. L., Mccall, D., & Mccall, D. (2014). Seeing may not mean believing: examining students ' understandings & beliefs in evolution. *The American Biology Teacher, 70*(9), 522–531. https://doi.org/10.1662/0002-7685-70.9.522.

Central Bureau of Statistics. (2018). Retrieved September 11, 2019, from https://www.cbs.gov.il

Cheng, K. L., & Chan, K. H. (2018). Evolution education in Hong Kong (1991–2016): a content analysis of the biology textbooks for secondary school graduates. In H. Deniz & L. A. Borgerding (Eds.), *Evolution Education Around the Globe* (pp. 315–333). https://doi.org/10.1007/978-3-319-90939-4_17.

Cho, M.-H., Lankford, D. M., & Wescott, D. J. (2011). Exploring the relationships among epistemological beliefs, nature of science, and conceptual change in the learning of evolutionary theory. *Evolution: Education and Outreach, 4*(2), 313–322. https://doi.org/10.1007/s12052-011-0324-7.

Clément, P. (2015). Muslim teachers' conceptions of evolution in several countries. *Public Understanding of Science, 24*(4), 400–421. https://doi.org/10.1177/0963662513494549.

Corbin, J. M., & Strauss, A. L. (2008). Basics of qualitative research: techniques and procedures for developing grounded theory (3rd ed.). https://doi.org/10.4135/9781452230153

Coyne, J. A. (2012). Science, religion, and society: the problem of evolution in America. *Evolution, 66*(8), 2654–2663. https://doi.org/10.1111/j.1558-5646.2012.01664.x.

Crane, A., & Livesey, S. (2017). Are you talking to me? In Routledge (Ed.), *Unfolding Stakeholder Thinking 2* (pp. 39–52). https://doi.org/10.4324/9781351281843-3.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory Into Practice, 39*(3), 124–130. https://doi.org/10.1207/s15430421tip3903.

DeJaeghere, J. G., Chapman, D. W., & Mulkeen, A. (2006). Increasing the supply of secondary teachers in sub-Saharan Africa: A stakeholder assessment of policy options in six countries. *Journal of Education Policy, 21*(5), 515–533. https://doi.org/10.1080/02680930600866116.

Devers, K. J., & Frankel, R. (2000). Study design in qualitative research-2 : sampling and data collection strategies. *Education for Health, 13*(2), 263–271.

Dey, I. (1999). *Grounding grounded theory: guidelines for qualitative inquiry.* San Diego: Academic Press.

Dickerson, D. L., Dawkins, K. R., & Penick, J. E. (2008). Clergy's views of the relationship between science and religious faith and the implications for science education. *Science & Education, 17*(4), 359–386. https://doi.org/10.1007/s11191-007-9099-1.

Dodick, J., Dayan, A., & Orion, N. (2010). Philosophical approaches of religious Jewish science teachers toward the teaching of "controversial" topics in science. *International Journal of Science Education, 32*(11), 1521–1548. https://doi.org/10.1080/09500690903518060.

Dodick, J., & Shuchat, R. B. (2014). Historical interactions between Judaism and science and their influence on science teaching and learning. In M. R. Matthews (Ed.), *International Handbook of Research in History, Philosophy and Science Teaching* (pp. 1721–1757). https://doi.org/10.1007/978-94-007-7654-8_54.

Dotger, S., Dotger, B. H., & Tillotson, J. (2010). Examining how preservice science teachers navigate simulated parent-teacher conversations on evolution and intelligent design. *Science Education, 94*(3), 552–570. https://doi.org/10.1002/sce.20375.

Eder, E., Seidl, V., Lange, J., & Graf, D. (2018). Evolution education in the German-speaking countries. In H. Deniz & L. A. Borgerding (Eds.), *Evolution Education Around the Globe* (pp. 235–260). https://doi.org/10.1007/978-3-319-90939-4_13.

Edis, T. (2008). Modern science and conservative Islam: an uneasy relationship. In *Science, Worldviews and Education* (pp. 237–255). https://doi.org/10.1007/978-90-481-2779-5_12.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing, 62*(1), 107–115.

Francis, J. F. (1995). Creationism v. Evolution: The Legal History and Tennessee's Role in That History. *Tennessee Law Review, 63*, 753–774.

Freeman, R. E. (1984). *Strategic management: a stakeholder approach* (Boston: Pi).

Freeman, R. E., & McVea, J. (2001). A stakeholder approach to strategic management. In *The Blackwell handbook of strategic management* (pp. 189–207).

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: strategies for qualitative research.* Chicago: Aldine Pub. Co..

Glatthorn, A. A., Boschee, F., Whitehead, B. M., & Boschee, B. F. (2018). *Curriculum leadership: strategies for development and implementation.* Thousand Oaks: Sage PublicationsSage CA.

Glaze, A. L., & Goldston, M. J. (2015). U.S. Science teaching and learning of evolution: a critical review of the literature 2000-2014. *Science Education, 99*(3), 500–518. https://doi.org/10.1002/sce.21158.

Goodlad J.I. (1979). *Curriculum inquiry. The Study of Curriculum Practice.* (N. 10020 McGraw-Hill Book Company, 1221 Avenue of the Americas, New York, Ed.)

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 24*(2), 105–112. https://doi.org/10.1016/j.nedt.2003.10.001.

Hall, G. E., & Woika, S. A. (2018). The fight to keep evolution out of schools: the law and classroom instruction. *The American Biology Teacher, 80*(3), 235–239. https://doi.org/10.1525/abt.2018.80.3.235.

Hameed, S. (2008). Bracing for Islamic creationism. *Science, 322*(5908), 1637–1638. https://doi.org/10.1126/science.1163672.

Heddy, B. C., & Sinatra, G. M. (2013). Transforming misconceptions: using transformative experience to promote positive affect and conceptual change in students learning about biological evolution. *Science Education, 97*(5), 723–744. https://doi.org/10.1002/sce.21072.

Hermann, R. S. (2008). Evolution as a controversial issue: a review of instructional approaches. *Science & Education, 17*(8–9), 1011–1032. https://doi.org/10.1007/s11191-007-9074-x.

Hildebrand, D., Bilica, K., & Capps, J. (2008, September). Addressing controversies in science education: a pragmatic approach to evolution education. *Science & Education, 17*, 1033–1052. https://doi.org/10.1007/s11191-006-9066-2.

Hill, J. P. (2014). Rejecting evolution: the role of religion, education, and social networks. *Journal for the Scientific Study of Religion, 53*(3), 575–594. https://doi.org/10.1111/jssr.12127.

Israeli Ministry of Education. (2012). Retrieved from http://cms.education.gov.il/EducationCMS/Units/Rama/MivchanimBenLeumiyim/PISA+2012.htm

Israeli Ministry of Education. (2019). Retrieved September 16, 2019, from https://edu.gov.il/owlHeb/Pages/default.aspx

Kagan, T., & Sanders, M. (2013). Use of confidence scales in analysing unscientific ideas about evolution among religious Jewish students. *African Journal of Research in Mathematics, Science and Technology Education, 17*(1–2), 38–49. https://doi.org/10.1080/10288457.2013.826969.

Kampourakis, K. (2015). The need for interdisciplinary dialog in evolution education: a comment on the responses by Ware & Gelman and Shtulman. *Cognitive Science, 39*(4), 846–848. https://doi.org/10.1111/cogs.12200.

Kampourakis, K., & Nehm, R. H. (2014). History and philosophy of science and the teaching of evolution: students' conceptions and explanations. In *International Handbook of Research in History, Philosophy and Science Teaching* (pp. 377–399). https://doi.org/10.1007/978-94-007-7654-8_13.

Kampourakis, K., & Strasser, B. J. (2015). The evolutionist, the creationist, and the 'unsure': picking-up the wrong fight? *International Journal of Science Education, Part B: Communication and Public Engagement, 5*(3), 271–275. https://doi.org/10.1080/21548455.2014.931613.

Kentucky Department of Education. (2013). Retrieved from https://education.ky.gov/curriculum/conpro/science/Pages/Next-Generation-Science-Standards.aspx

Kerzner, H. (2017). Project management: a systems approach to planning, scheduling, and controlling (12th ed.) . Retrieved from https://books.google.co.il/books?hl=iw&lr=&id=xlASDgAAQBAJ&oi=fnd&pg=PR19&dq=The+stakeholders+recommend+and+plan+new+directions+for+a+firm+&ots=Xb6qXUR_xS&sig=rB6sVJgotuGTozHOZXDENL4DEog&redir_esc=y#v=snippet&q= stakeholder&f=true.

Kloser, M. (2014). Identifying a core set of science teaching practices: a Delphi expert panel approach. *Journal of Research in Science Teaching, 51*(9), 1185–1217. https://doi.org/10.1002/tea.21171.

Könings, K. D., Seidel, T., & van Merriënboer, J. J. G. (2014). Participatory design of learning environments: Integrating perspectives of students, teachers, and designers. *Instructional Science, 42*(1), 1–9. https://doi.org/10.1007/s11251-013-9305-2.

Kranthi, K. (2017). Curriculum development. *IOSR Journal Of Humanities And Social Science, 22*(2), 1–5. https://doi.org/10.9790/0837-2202030105.

Kvale, S. (1994). *Interviews: an introduction to qualitative research interviewing*. Inc: Sage Publications.

Long, D. E. (2012). The politics of teaching evolution, science education standards, and being a creationist. *Journal of Research in Science Teaching, 49*(1), 122–139. https://doi.org/10.1002/tea.20445.

Lyons, S. L. (2010). Evolution and education: lessons from Thomas Huxley. *Science & Education*, 19(4–5), 445–459. https://doi.org/10.1007/s11191-009-9188-4.

Martin-hansen, L. M. (2008). First-year college students ' conflict with religion and science. *Science & Education, 17*(4), 317–357. https://doi.org/10.1007/s11191-006-9039-5.

Masci, D. (2014). The social and legal dimensions of the evolution debate in the U.S. Retrieved from Pew Research Center's Religion & Public Life Project website: https://www.pewforum.org/2009/02/04/the-social-and-legal-dimensions-of-the-evolution-debate-in-the-us/

Mays, N., & Pope, C. (2000). Assessing quality in qualitative research. *BMJ-British Medical Journal, 320*(7226), 50–52.

McComas, W. F., & Olson, J. K. (1998). The nature of science in international science education. *The Nature of Science in Science Education,* 41–52. https://doi.org/10.1007/0-306-47215-5_2.

McNeill, K. L., & Berland, L. (2017). What is (or should be) scientific evidence use in k-12 classrooms? *Journal of Research in Science Teaching, 54*(5), 672–689. https://doi.org/10.1002/tea.21381.

Miller, J. D., Scott, E. C., & Okamoto, S. (2006). Public acceptance of evolution. *Science, 313*. https://doi.org/10.1126/science.1126746.

Ministry of Education. (1990). *Biology curriculum, 7 th to 12 th grade*. Retrieved from http://meyda.education.gov.il/files/Mazkirut_Pedagogit/AgafMadaim/TochnitLimodim_Bio_1990(1).pdf

Ministry of Education. (1996). *Science and technology curriculum, 7th to 9th grade (Hebrew)*. Retrieved from http://meyda.education.gov.il/files/Mazkirut_Pedagogit/AgafMadaim/Tochnit_Limodim_madaThch_hativa1996.pdf

Ministry of Education. (2010). *Syllabus of biological studies (10th–12th grade)*. Retrieved from http://meyda.education.gov.il/files/Mazkirut_Pedagogit/AgafMadaim/TochnitLimodim_Bio_2010.pdf

Ministry of Education. (2016a). *Biology curriculum, 10th to 12 grade*. Retrieved from http://meyda.education.gov.il/files/Mazkirut_Pedagogit/AgafMadaim/TochnitLimodim_Bio_2010.pdf

Ministry of Education. (2016b). *Science and technology curriculum*. Retrieved from http://cms.education.gov.il/EducationCMS/Units/Mazkirut_Pedagogit/MadaTechnologya/tochnitLimudim/hatab+tl.htm

Moore, A. (2008). Science teaching must evolve. *Nature, 453*(7191), 31–32. https://doi.org/10.1038/453031a.

Nehm, R. H., Kim, S. Y., & Sheppard, K. (2009). Academic preparation in biology and advocacy for teaching evolution: biology versus non-biology teachers. *Science Education, 93*(6), 1122–1146. https://doi.org/10.1002/sce.20340.

Next Generation Science Standards. (2013). *Topic arrangements of the next generation science standards*. Retrieved from https://www.nextgenscience.org

Osborne, J., Collins, S., Ratcliffe, M., Millar, R., & Duschl, R. (2003). What "ideas-about-science" should be taught in school science? A delphi study of the expert community. *Journal of Research in Science Teaching, 40*(7), 692–720. https://doi.org/10.1002/tea.10105.

Owens, D. C., Pear, R. S. A., Alexander, H. A., Reiss, M. J., & Tal, T. (2018). Scientific and religious perspectives on evolution in the curriculum: an approach based on pedagogy of difference. *Research in Science Education, 48*(6), 1171–1186. https://doi.org/10.1007/s11165-018-9774-z.

Pear, R. S. A., Klein, M., & Berger, D. (2015). Report from the field: a pilot project on the teaching of Jewish views of evolution in Israel. *International Journal of Jewish Education Research, 25*(8), 59–66.

Pear, R. S. A. (2018). Agreeing to disagree: American orthodox Jewish scientists' confrontation with evolution in the 1960s. *Religion and American Culture: A Journal of Interpretation, 28*(02), 206–237. https://doi.org/10.1525/rac.2018.28.2.206.

Pennock, R. T. (2002). Should creationism be taught in the public schools? *Science and Education, 11*(2), 111–133. https://doi.org/10.1023/A:1014473504488.

Pigliucci, M. (2013). When science studies religion: six philosophy lessons for science classes. *Science & Education, 22*(1), 49–67. https://doi.org/10.1007/s11191-011-9355-2.

Reiss, M. J. (2011). How should creationism and intelligent design be dealt with in the classroom? *Journal of Philosophy of Education, 45*(3), 399–415. https://doi.org/10.1111/j.1467-9752.2011.00790.x.

Rissler, L. J., Duncan, S. I., & Caruso, N. M. (2014). The relative importance of religion and education on university students' views of evolution in the deep south and state science standards across the United States. *Evolution: Education and Outreach, 7*(1), 24–41. https://doi.org/10.1186/s12052-014-0024-1.

Ritchie, J. (2003). The applications of qualitative methods to social research. In J. Ritchie & J. Lewis (Eds.), *Qualitative research practice: A guide for social science students and researchers (p. 24)*. Sage Publications, Inc..

Rutledge, M. L., & Mitchell, M. A. (2002). High school biology teachers' knowledge structure, acceptance & teaching of evolution. *The American Biology Teacher, 64*(1), 21–28.

Sanders, M. (2018). The unusual case of evolution education in South Africa. In *Evolution Education Around the Globe* (pp. 409–428). https://doi.org/10.1007/978-3-319-90939-4_22.

Siani, M., & Ben-Zvi Assaraf, O. (2017). A qualitative look into Israeli genetic experts' insights regarding culturally competent genetic counseling and recommendations for its enhancement. *Journal of Genetic Counseling, 26*(6), 1254–1269. https://doi.org/10.1007/s10897-017-0104-9.

Skoog, G. (2005). The coverage of human evolution in high school biology textbooks in the 20th century and in current state science standards. *Science & Education*, 14(3–5), 395–422. https://doi.org/10.1007/s11191-004-5611-z.

Skoog, G., & Bilica, K. (2002). The emphasis given to evolution in state science standards: a lever for change in evolution education? *Science Education, 86*(4), 445–462. https://doi.org/10.1002/sce.10014.

Smith, M. U. (2010). Current status of research in teaching and learning evolution: II. Pedagogical issues. *Science & Education, 19*(6), 539–571. https://doi.org/10.1007/s11191-009-9216-4.

Smith, M. U., & Siegel, H. (2016). On the relationship between belief and acceptance of evolution as goals of evolution education. *Science & Education, 25*(5–6), 473–496. https://doi.org/10.1007/s11191-016-9836-4.

Stasinakis, P. K., & Kampourakis, K. (2018). Teaching evolution in Greece.. In *Evolution Education Around the Globe* (pp. 195–212) https://doi.org/10.1007/978-3-319-90939-4_11.

Stolberg, T. L. (2010). Teaching Darwinian evolution: learning from religious education. *Science & Education, 19*(6–8), 679–692. https://doi.org/10.1007/s11191-009-9187-5.

Suprayogi, M. N., Valcke, M., & Godwin, R. (2017). Teachers and their implementation of differentiated instruction in the classroom. *Teaching and Teacher Education, 67*, 291–301. https://doi.org/10.1016/j.tate.2017.06.020.

Svendsen, A. (1998). *The stakeholder strategy: profiting from collaborative business relationships*. Berrett-Koehler Publishers.

Swetlitz, M. (2013). Judaism, Jews, and evolution. In M. Ruse (Ed.), *The Cambridge encyclopedia of Darwin and evolutionary thought* (pp. 493–498). Cambridge: Cambridge University Press.

Thagard, P., & Findlay, S. (2010). Getting to Darwin: obstacles to accepting evolution by natural selection. *Science & Education, 19*(6–8), 625–636. https://doi.org/10.1007/s11191-009-9204-8.

The Steinhardt Museum of Natural History. (2019). Retrieved October 7, 2019, from https://smnh.tau.ac.il/

Trigwell, K., Prosser, M., & Waterhouse, F. (1999). Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education, 37*(1), 57–70. https://doi.org/10.1023/A:1003548313194.

Truong, J. M., Barnes, M. E., & Brownell, S. E. (2018). Can six minutes of culturally competent evolution education reduce students' level of perceived conflict between evolution and religion? *The American Biology Teacher, 80*(2), 106–115. https://doi.org/10.1525/abt.2018.80.2.106.

Unsworth, A., & Voas, D. (2018). Attitudes to evolution among Christians, Muslims and the non-religious in Britain: differential effects of religious and educational factors. *Public Understanding of Science, 27*(1), 76–93. https://doi.org/10.1177/0963662517735430.

van den Akker, J. (2003). Curriculum perspectives: an introduction. In *Curriculum Landscapes and Trends* (pp. 1–10). https://doi.org/10.1007/978-94-017-1205-7_1.

van den Heever, J. . (2009). Creationism in the colonies: science, religion and the legacy of apartheid in South Africa. *Proceedings of the Fourteenth Conference of the South African Science and Religion Forum (SASRF) of the Research Institute for Theology and Religion. University*, 280. Retrieved from http://hdl.handle.net/10500/4291

Weisberg, D. S., Landrum, A. R., Metz, S. E., & Weisberg, M. (2018). No missing link: Knowledge predicts acceptance of evolution in the United States. *BioScience, 68*(3), 212–222. https://doi.org/10.1093/biosci/bix161.

Williams, J. D. (2015). Evolution versus creationism: a matter of acceptance versus belief. *Journal of Biological Education, 49*(3), 322–333. https://doi.org/10.1080/00219266.2014.943790.

Yasri, P., & Mancy, R. (2016). Student positions on the relationship between evolution and creation: what kinds of changes occur and for what reasons? *Journal of Research in Science Teaching, 53*(3), 384–399. https://doi.org/10.1002/tea.21302.

Yok, M. C. K., Clément, P., Leong, L. K., Shing, C. L., & Ragem, P. A. (2015). Preliminary results on Malaysian teachers conception of evolution. *Procedia - Social and Behavioral Sciences, 167*, 250–255. https://doi.org/10.1016/j.sbspro.2014.12.670.

Zer Kavod Galia. (2018). *Review of biology curricula for high schools around the world.* Retrieved from http://education.academy.ac.il/Index4/Entry.aspx?nodeId=992&entryId=21115

Ziadie, M. A., & Andrews, T. C. (2018). Moving evolution education forward: a systematic analysis of literature to identify gaps in collective knowledge for teaching. *CBE Life Sciences Education, 17*(1), 1–10. https://doi.org/10.1187/cbe.17-08-0190.