Religious Beliefs: a hidden variable in the performance of science teachers in the classroom

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ABSTRACT This article focuses on some of the challenges of teaching science in a culture where science and religion sometimes appear to be or are set at odds with each other. Apparent conflicts between scholarly claims and religious claims are not limited to science, however – they occur in almost every subject. Many topics included in science education are acknowledged as controversial issues, for example, evolution, cloning, abortion and genetic engineering. These issues pose problems for science teachers, especially in a religiously based culture, because of the nature of the conflict between the implications of a scientific study of some of these issues and religion. Some other issues may not formally conflict with religion but teachers’ views, or the way they interpret the religious view regarding these controversial issues, can create a false contradiction, which might influence their performance and, in turn, influence their students’ learning. Therefore, there is a need to understand teachers’ personal religious beliefs and practices around some of these, and the way their beliefs influence their performance in the classroom. This article describes a study conducted to address these needs. The study looks at the role and influence of religion on the science teacher’s performance. The findings highlighted the powerful influence of teachers’ religious beliefs in dealing with or gaining new knowledge (the epistemology and the ontology of science). Also, the findings found that teachers’ religious beliefs are among the major constructs that drive teachers’ ways of thinking and classroom practices about scientific issues related to religion.

Introduction

Human beings have all sorts of beliefs. Some are based on personal experience, others on education, and others on indoctrination (Davies, 1992, p. 19). Beliefs are the best indicators of the decisions people make in their lives; however, there is still much debate as to whether pedagogical beliefs influence actions or actions influence these beliefs. For example, Pajares (1992) supported the notion that teachers’ beliefs influence their perceptions, which in turn affects their behaviours in the classroom. In short, people act upon what they believe. Similarly, Ajzen (1985) suggested that beliefs develop a person’s value system that guides life’s behaviours, while Ernest (1988) argued that in mathematics, teachers’ beliefs have a powerful impact on the practice of teaching during their transformation into practice. In the same regard, Clark & Peterson (1986, p. 258) described teachers’ beliefs and theories as ‘the rich store of knowledge that teachers have that affects their planning and their interactive thoughts and decisions’.

Educational beliefs in general and teachers’ beliefs in particular are not context-free (Pajares, 1992; Fang, 1996). Calderhead (1996) indicates that teachers’ beliefs and the context in which their
beliefs are developed and used should be taken into consideration in order to have a better understanding of how teaching and learning occurs in classrooms and can thus be enhanced. Therefore, teachers’ own understanding of their work will shed light on how they make sense of their practices, and how these perceptions affect their decisions about teaching and learning. So, we have to take into account the contextual factors that have shaped and formed certain beliefs. Thus, researchers must study the context-specific features of beliefs in terms of the connection of beliefs with other belief systems and contextual issues (Pajares, 1992). In the same respect, a recent study by Mansour (2008) produced evidence that personal religious experience is one of the most influential social factors on the experience of science teachers and on gaining new experience or even interpreting these experiences, and that this, in turn, influences teachers’ pedagogical beliefs and practices. Mansour (2008) distinguishes between individual religious beliefs that are based on ‘Holy scripture and the sayings of God’s Prophet’ and personal religious beliefs which the individual forms through his/her life experience. Mansour (2008) also maintains that personal religious belief (PRB) was one of the most powerful factors influencing science teachers’ performance, arguing that PRB, as a social construct, might have no roots in religion at all. He defines PRB as views, opinions, attitudes, and knowledge constructed by a person through interaction with his/her socio-cultural context through his/her life history and interpreted as having their origins in religion. The PRB works as a framework for understanding events, experiences and objects on an individual level. It is a social construct based broadly on the various experiences (and more particularly on the religious experiences) that a person lives through. Since PRBs are a product of the interactions among all the experiences that the person accumulates, and depend on the socio-cultural context in which the individual has been brought up. (Mansour, 2008, p. 1608)

In terms of religion as a context of teaching/learning science, there are many challenges for science teachers, especially in Islamic countries. In most cases, the Muslim scientist or a Muslim science teacher is split between his/her profession as a scientist or as a teacher and his/her value system as a believer (Kalin, 2006). However, students should graduate from schools with a better understanding of the nature of science and how it proceeds (Loving & Foster, 2000). At the same time, students should have values, morals and ethics so that they can use this science for the benefit of their societies. Reiss (1993) emphasizes that science teachers should help their students to develop their scientific knowledge and understanding of how scientific ideas change through time, and how their nature and the use to which they are put will be affected by the social, moral, spiritual and cultural contexts in which they are developed.

In terms of the influence of social context on teachers’ beliefs and practices, most of the studies of beliefs in general, and of science and religion in particular, have been carried out in Western cultures, not in Islamic culture. Therefore, in this different context, the current study may give new insights into the dynamics of the relationship between teachers’ views of the relationship between science and religion and science education. Moreover, many topics included in science education are acknowledged as controversial, for example, evolution, cloning, abortion and genetic engineering. These issues pose problems for science teachers, especially in Islamic countries, because of the nature of the conflict between the implications of a scientific study of some of these issues and the Islamic religion. Some other issues may not formally conflict with Islam, but teachers’ personal religious beliefs or the way they interpret the Islamic view regarding these controversial issues can create a false contradiction (Mansour, 2008).

The crisis of legitimacy related to the scientific world view of modern natural sciences has a deep impact on how people in the Islamic world relate to the question of science on the one hand, and their intellectual and scientific tradition on the other. Regardless of what particular position one takes, this debate has two important components. The first is associated with the practical needs and concerns of Muslim countries. Keeping up with modern science and technology is the number one priority for governments in the Muslim world. The goal has remained the same: to fill the gap between Western and Islamic societies by empowering Muslim countries with the tools and blessings of modern science. The second component of the debate over Islam and science in Muslim societies concerns the intellectual domain, which links the discussion both to modern science and its philosophical foundations and to the Islamic scientific tradition, as an alternative way of studying the order of nature (Kalin, 2006). This paper focuses on how Muslim science
teachers in Egypt have responded to this debate, and what possible positions may be expected to arise from these responses.

The debate about Islam and science extends to a debate about the relationship between Islam and science education. Loo (2001, p. 64) highlights that debate: ‘Islamic science, for better or worse, impacts upon science education to the extent that it humanizes or marginalizes science education in Muslim-majority countries.’ Religion has become the keeper of values that translate into the building blocks of secular society. Science, for its part, has removed many of the unknowns and the unknowable, and has again and again pushed back the frontiers of knowledge in ways that challenge the mystery in many religious explanations (Katz, 2002). The scientist whose deep regard for nature embraces a dimension of moral responsibility and fear is not far from religion. Similarly, the religious believer who seeks to understand the world because it has a deep significance (or is even rooted in God, for theistic religions) and who wishes to live harmoniously with nature – such a religious believer is not far from science (Hefner, 2002).

Loo (2001) argues that Islam, as one of the world’s major religions, clearly has had, and will continue to have, a very important role in mediating the interaction between the philosophical and the social/cultural/religious environments of science. It is very difficult to distinguish between science and religion in the enterprise of world building (Hefner, 2002). Kamali (2003) argues that religion is concerned with the totality of existence both in this world and the next. Science concerns itself with this world in a restricted sense.

Religion is not physics or chemistry seeking an explanation of Nature in terms of causation; it really aims at interpreting a totally different area of human experience – religious experience – the data of which cannot be reduced to the data of any other science. In fact, it must be said, in fairness to religion, that it insisted on the necessity of concrete experience in religious life long before science learned to do so. The conflict between the two is not due to the fact that one is, and the other is not, based on concrete experience (Iqbal, 2005). Religion is not as disinclined towards science as science is towards religion. Religion does not reject scientific truth, while science does reject religious truth (Kamali, 2003). Both seek concrete experience as a point of departure. Their conflict is due to the misapprehension that both interpret the same data of experience (Iqbal, 2005). Religion and science encounter each other most significantly in the human effort to put the world together in a viable, meaningful way (Hefner, 2002). An examination of the history of Islam tells us that there was a dynamic period of discovery and innovation in all spheres of knowledge within Islam (Al-Hayani, 2005).

The main argument of this study is that there is compatibility between science and religion, and the main role of science educators is to reflect this compatibility in science curricula. On the one hand, religion needs science for its world building if its interpretations are to be credible and possess glowing actuality. On the other, science needs religion because, unless its knowledge is incorporated into meaningful world building, science forfeits its standing as a humanistic enterprise and instead may be accounted for as anti-human methodology and body knowledge (Hefner, 2002). In this respect, Kamali (2003) argues that the debate over the compatibility of Islam and science still continues to raise two opposite views: one rejects the vision and feasibility of a compromise between science and religion, while the other sees a compromise not only as reasonable but also as necessary if an equilibrium of values is to be kept in perspective.

**Research Questions**

The main research question is: ‘To what extent does religion affect science teachers’ performance?’ To answer this question, the study poses the following subquestions:

1. **What are science teachers’ views of the relationship between religion and science?**
2. **Do teachers’ religious beliefs have an influence on the way they teach science or on some other involvement with science education?**
Background to the Educational System in Egypt

School Education in Egypt

Two separate educational systems exist in Egypt: a secular system for technological, practical, specialized training and a non-secular system, Al-Azhar, based on spiritual and cultural instruction. Both have several parallel phases. In addition, there are private schools at all grade levels. This study focuses on the secular system. Compulsory education, which lasts for nine grades, is known as ‘basic education’, and is split into two stages: primary school (grades 1 to 6) and preparatory school (grades 7 to 9). It leads to the award of the Basic Education Completion Certificate (BECC). Following the nine years of basic education, pupils have the choice of an academic option – entering a general secondary school – or a technical option, including three- and five-year technical schools, as well as experimental schools teaching languages, education and physical education. Only general secondary school graduates may be admitted to university after obtaining their General Secondary Education Certificate (GSEC) or an Advanced Technical Diploma (with scores above 75%). However, since 1991 some graduates from technical schools have been allowed to enter higher education. Table I shows the current secular education system in Egypt. This study focused on science teachers working in preparatory secular schools.

<table>
<thead>
<tr>
<th>University, higher and intermediate institutes</th>
<th>Technical secondary schools (ages 15-18)</th>
<th>Grades 10-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary stage</td>
<td>Preparatory stage (ages 12-15)</td>
<td>Grades 7-9</td>
</tr>
<tr>
<td>Basic education</td>
<td>Primary stage (ages 6-12)</td>
<td>Grades 1-6</td>
</tr>
</tbody>
</table>

Table I. The secular education system in Egypt.

The Place of Science in the National Curriculum

Science has been a basic subject in the central national curriculum since the 1960s, which traditionally included integrated science at primary and preparatory levels, and separated science (chemistry, physics and biology) at the secondary level. Table II shows the structure of the science curriculum since 1994.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Grade</th>
<th>Curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>1, 2, 3</td>
<td>No science curriculum</td>
</tr>
<tr>
<td></td>
<td>4, 5, 6</td>
<td>Integrated science</td>
</tr>
<tr>
<td>Preparatory</td>
<td>7, 8, 9</td>
<td>Integrated science</td>
</tr>
<tr>
<td>Secondary</td>
<td>10, 11, 12</td>
<td>Separated science – chemistry, physics and biology</td>
</tr>
</tbody>
</table>

Table II. Science in the Egyptian national curriculum.

Science Teacher Education in Egypt

There are two kinds of pre-service science teacher education programmes in faculties of education in Egypt. One prepares elementary science teachers to teach in primary schools (ages 6 to 12). This programme takes four years and leads to a B.Sc. in Primary Education. The second prepares science teachers for teaching in both preparatory (ages 12 to 15) and secondary education (ages 15 to 18). It has two departments. One is the Physics and Chemistry Education department, which prepares science teachers to specialize as physics teachers or chemistry teachers in secondary schools. The second is the Biology Education department, which prepares science teachers to specialize as biology teachers in secondary schools. The second programme also takes four years, and leads to a B.Sc. in Secondary Education. Graduates from this programme begin their teaching career in preparatory schools and are later promoted into secondary education.
The Author’s Ontological and Epistemological Views of Science and Religion

For me, Islamic religion is concerned with the totality of existence both in this world and the next, whereas science concerns itself with this world alone. Science is that branch of knowledge which deals with the material world. Religion is not as averse to science, one might say, as science is to religion. This is because religion does not reject scientific truth, whereas science does reject the religious truth. I do understand and believe that religion and science are not in total harmony, but the tension that exists between them need not be exaggerated either. Also, I do believe that human beings can remain spiritual and religious while enjoying the benefits of technology and science.

For this author personally, as a Muslim science educator, evolution theory, or even cloning, is part of scientific-historical thought, created by humans and therefore a kind of human creativity. In terms of teaching/learning science, it should not be a matter of war between the science teachers who do or do not believe these theories and their students who might or might not agree with them. What matters is how these countervailing issues are delivered and presented in the science curricula and in the classroom. In fact, it is necessary to deliver science not just as content, but also as a challenge to one’s thoughts and beliefs. Students must be made aware of the fact that different civilizations have different world views and will consequently be underpinned by different assumptions in different civilizational contexts.

My scientific background is based on studying natural sciences within my B.Sc. degree in Physics and Chemistry at the Faculty of Education, Tanta University, Egypt. I did not think about the relationship between science and religion in science education until I went to England to get my Ph.D. When I started collecting data (interviews and observations) for my Ph.D. research, teachers’ personal religious beliefs struck me and challenged my thoughts about delivering controversial issues within science education in an Islamic context. Also, having lived in a multicultural society like England, I started to question this relationship and why we take it for granted and do not highlight it in our science classrooms, or try strongly to avoid it until one of our students asks about it and does not get a proper answer. Why do we hide our views regarding the relationship between science and religion in our classrooms and our curriculum, and consider it a very sensitive issue for most Muslim science teachers or even most Muslims?

As a Muslim researcher on the relationship between science and religion, I do believe that my view and my participants’ view of controversial scientific issues related to religion is a personal understanding, which I call ‘personal religious belief’ and define as

views, opinions, attitudes, and knowledge constructed by a person through interaction with his/her socio-cultural context through his/her life history and interpreted as having their origins in religion ... It is a social construct based broadly on the various experiences (and more particularly on the religious experiences) that a person lives through. [It] depend[s] on the socio-cultural context in which the individual has been brought up. (Mansour, 2008, p. 1608)

As a researcher, to study this complex and sensitive issue, I negotiated the interpretation of the data that I collected with the participating teachers. I worked to reconstruct an understanding of the participants’ experience through a process of synthesizing data so categories and themes emerged as the data revealed the interconnections (Bogdan & Biklen, 1992).

During the research, I conducted peer-debriefing sessions that consisted of conferring with a disinterested peer during the analysis of the data to expose my biases as a researcher. Two peers were experienced preparatory science teachers in Egypt. In the process of debriefing, the peer was provided with the actual data and findings of initial analysis. I explained the steps I had taken during the analysis and encouraged the peer debriefer to ask questions at any time. The debriefing sessions served the purpose of clearing any feelings I had that may have clouded my judgment and prevented the next logical steps in the research process.

Methodology

Bell (1993) argues that a qualitative approach is appropriate for understanding individual feelings, experiences, attitudes, beliefs, etc. In the same vein, Calderhead (1996) indicates the appropriateness of qualitative study for investigating teachers’ roles in education. He particularly argues that research into teachers’ beliefs, experiences, contributions and involvement in
innovation demands a qualitative approach. Munby (1984) undertook a qualitative study of the beliefs of the teacher, discussing their beliefs and principles in relation to qualitative research approaches and emphasizing the insufficiency of a positivist scientific paradigm. However, Poulson et al (2001) refer to the investigation of teachers’ beliefs as complicated, so that there is a need for methodological diversity. Therefore, the current study has used a range of data and an overall interpretive methodology to attempt to gain an in-depth understanding of Egyptian science teachers’ views about science and religion, and why they hold different views. The study adopted a constructivist perspective using an interpretive approach. The research was guided by teachers’ world views of science and religion, which I regarded as their socially constructed realities.

Data Collection

Data were collected by means of a semi-structured interview and an open-ended questionnaire. The main research tool in this study was the interviews and the questionnaire was used as a pilot study or preliminary study towards choosing the interviewees and developing the interview protocol.

Open-ended Questionnaire

This questionnaire was designed to cover a sample with different views about the relationship between science and religion, and also with different views about the teaching/learning of science and religious issues. Within the questionnaire there were six open-ended questions:

Q1. How do you see the relationship between science and religion?
Q2. Who do you think should be responsible for teaching the relationship between science and religion, religious education, or science education? Why?
Q3. Does your religious conceptions affect the way you teach science? How?
Q4. When can you start teaching the relationship between science and religion?
Q5. Do you feel confident or worried when you teach science/religion issues (for example, cloning, evolution, creation)? And how do you teach these topics?
Q6. Do you run any training programmes or workshops about the controversial issues and how you teach them? If you say yes, could you please give some details about these workshops?

Interviews

Cohen & Manion (1980) suggest that there are four kinds of interview: the structured interview, the unstructured interview, the non-directive interview and the focused interview. Radnor (2001) and Denscombe (2001) refer to another type of interview: the semi-structured interview. However, I chose to have a semi-structured interview where I would be able to keep an open mind and would also be open to ideas that I would encounter as well as ideas that I would not have expected, as I could not predict what would emerge from the participants’ responses.

Most of the interview questions were prepared in advance by considering the relevant literature (Reiss, 1993; Colburn & Henriques, 2006; Mansour, 2008). The analysis of the questionnaire results also guided the development of this study’s interview protocol. The order of the questions was modified and some questions were added or varied as the interviews unfolded. Also, the wordings of the questions were varied to ensure the participants grasped their meaning. The interviews were audiotaped and then transcribed immediately after the interview. The transcripts were returned to each of the teachers before the beginning of the following interview for their scrutiny and confirmation or criticism. I also did an initial analysis of the interview after each one, and made notes on a covering sheet to act as a framework for subsequent questions. Thus, the process was concerned with ‘the unique, the idiosyncratic, and the wholly individual viewpoint’ (Guba & Lincoln, 1989, pp. 155-156). All the interviews lasted approximately 30-45 minutes, and each interviewee had around 3 to 4 interviews.
Participants for the questionnaire included 75 Egyptian science teachers (45 males and 30 females), aged from their mid 30s to early 50s and with a variety of teaching expertise (from 5 to 25 years of teaching) and experience of teaching in different preparatory schools in Egypt’s Gharbiyya governorate.

In the quantitative analysis of the questionnaire, the author summarized teachers’ responses to the questionnaire (see Figure 1), then identified 15 teachers with the intention of clarifying and elaborating on their answers. From approximately 25 teachers who volunteered to be interviewed, 15 teachers were purposefully selected. The author’s selection of interviewees was guided by a ‘maximum variation strategy’ (Patton, 2002), which included teachers’ backgrounds, teaching subjects, gender, teaching experiences, and teachers who held representative views or contradictory personal visions about the relationships between science and religion, or ‘conflict’, ‘independence’, ‘dialogue’ and ‘integration’ (see Table III). The selection was also carried out on the basis of their enthusiasm for being interviewed. The interviewees are represented in this study by letters (A, B, C, D, E, F, G, H, I, J, K, L, M, N and O).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Category</th>
<th>n</th>
<th>%</th>
<th>Interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ways of relating science and religion</td>
<td>Conflict</td>
<td>5</td>
<td>6.7</td>
<td>A, B, C</td>
</tr>
<tr>
<td></td>
<td>Independence</td>
<td>10</td>
<td>13.3</td>
<td>D, E, F</td>
</tr>
<tr>
<td></td>
<td>Dialogue</td>
<td>14</td>
<td>18.7</td>
<td>G, H, I</td>
</tr>
<tr>
<td></td>
<td>Integration</td>
<td>46</td>
<td>61.3</td>
<td>J, K, L, M, N, O</td>
</tr>
<tr>
<td>Responsibility of teaching science and religion</td>
<td>Science education</td>
<td>40</td>
<td>53.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Religious education</td>
<td>15</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>20</td>
<td>26.7</td>
<td></td>
</tr>
<tr>
<td>Confidence in teaching science and religion issues</td>
<td>Confidence</td>
<td>30</td>
<td>40.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No confidence</td>
<td>45</td>
<td>60.0</td>
<td></td>
</tr>
<tr>
<td>Training in science and religion issues</td>
<td>Training</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No training</td>
<td>75</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Teaching preference of science and religion issues</td>
<td>Religious orientation</td>
<td>25</td>
<td>33.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scientific orientation</td>
<td>20</td>
<td>27.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Religio-scientific orientation</td>
<td>30</td>
<td>40.0</td>
<td></td>
</tr>
<tr>
<td>Attitude toward non-Muslim sciences</td>
<td>Negative</td>
<td>30</td>
<td>40.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>45</td>
<td>60.0</td>
<td></td>
</tr>
<tr>
<td>Start teaching science and religion in the classroom</td>
<td>If students ask</td>
<td>15</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If textbook mentions</td>
<td>50</td>
<td>67.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depends on the topic</td>
<td>10</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td>Start teaching science and religion according to grade</td>
<td>Primary</td>
<td>15</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preparatory</td>
<td>24</td>
<td>32.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>36</td>
<td>48.0</td>
<td></td>
</tr>
</tbody>
</table>

Table III. Responses to the open-ended questionnaire.

**Data Analysis**

The study used a ‘hermeneutical data analysis’ approach to analyze the questionnaires and the interviews. Hermeneutical analysis is an interpretive approach, since it emphasizes the importance
of the views of participants based on their experiences and their standpoint. Hermeneutics is primarily concerned with the meaning of a text, which the researcher comes to understand through oral or written text. The basic question in hermeneutics is: What is the meaning of this text? (Radnitzky, 1970, p. 20). One implication of this approach is the idea of ‘hermeneutic circles’, which is explained by Klein & Myers (1999). The idea of hermeneutic circles suggests that we come to understand a complex whole from preconceptions about the meanings of its parts and their interrelationships: i.e. the movement of understanding is constantly from the whole to the part and back to the whole.

According to this approach, analysis of the data focuses on interpreting and understanding the meanings revealed in the text. This process of analysis is carried out in six steps (Diekelmann et al, 1989). First, the researcher reads each transcript and questionnaire for each participant as one document in its entirety, to establish an overall understanding of the experience. The second step includes identifying categories within each case ‘participant’. In the third step, the researcher compares categories and looks for similarities and differences. Interpretations are supported with textual references from the interviews or the questionnaires. The fourth step is the identification of themes. Themes occur across most of the texts and are arrived at by reviewing and comparing the categories generated from each text. Themes also are supported by various textual references. The fifth step of analysis seeks to identify patterns in the themes that occur across the texts, and specifically examines relationships between and among identified themes. This is the highest level of interpretation. The sixth step validates the interpretation. People not involved with the research but who have knowledge of the content and the research method review the analysis for accuracy. Steps one through six do not occur in a linear fashion. As the research progresses, the researcher goes back to previous steps to clarify interpretations and understandings. This process continues until all data have been collected and analyzed.

The open-ended questionnaire was also evaluated quantitatively. In this evaluation, an attempt was made to count the dominant views regarding the relationship between science and religion among the science teachers.

Framework for Interpretation and Data Analysis

I used different theoretical frameworks in my study, which pushed it to focus on different aspects of the case studies, and produced notable differences in the data analysis, interpretation and in the conclusion. My interest in the theoretical framework of Barbour’s (2000) four views of science and religion, and Mansour’s (2008) PRB model drove all aspects of the study, from identifying its focus and the styles of teachers’ views of the relationship between science and religion, to an interpretation of how these styles are formed and the role of each style in the classroom. The work of Ian Barbour (2000) guided my data collection and analysis. Other theoretical frameworks influenced several aspects of the study. Mansour’s (2008) PRB model guided the process of interpretation about how religious beliefs can reflect on teachers’ performance in the science classroom or on their views about the role of science education or science teacher education. Mansour (2008) emphasizes the role of social context in building teachers’ PRB, as well as their views about the reality of science or religion (see Figure 1).
The PRB model also emphasizes the role of teachers’ interpretation of their experience, and how these interpretations about the relationship between science and religion can inform teachers’ decision making in the classroom. This framework was very important for the current study as a means of highlighting how the different types of relationships (conflict, independence, dialogue and integration) can be converted into actions in the classroom.

**Findings**

The findings of the study will be presented in two parts. The first part demonstrates teachers’ views about science and religion, which will answer the first research question. The second part presents the impact of teachers’ views about science and religion on their delivery of science in the classroom, which will answer the second research question.

**Science Teachers’ Views of Science and Religion**

The data analysis showed that a central theme underlying the responses of almost all the research participants was ‘religion comes first and science comes next’. However, a finer level of data analysis confirmed that those participants’ views of the relationship between science and religion fall into four categories which are overlapping and allied to form, and confirm the centrality of teachers’ PRBs in their thoughts and views concerning science and religion issues.

**Conflict from the ‘Science’ Side**

As shown in Table III, only 5 teachers out of the 75 respondents (6.7%) viewed a conflict relationship between science and religion. The 5 teachers expressed the view that the conflict arose from scientists who failed to consider the religious viewpoint in their work, especially in Western societies. For example, teacher B said:
Science and religion sometimes conflict in the Western societies, for example, transplantation and trading in human organs. But in Egypt and other Islamic societies, right and wrong are distinctive.

Evolution versus creation was the main reason for viewing a conflict between science and religion. For example, teacher A (a biology teacher) argued that the Qur’anic account of creation was incompatible with man having evolved:

I do not agree with Darwin who claimed that all the organic beings which have ever lived on this earth have descended from one primal form. I do believe that as comes on the Holy Qur’an that our first ancestor was the Adam (upon whom be peace), who was created by Allah.

Teacher A supported his argument with verses from the Qur’an:

It is He Who created you from a single person, and made his mate of like nature, in order that he might dwell with her (in love). When they are united, she bears a light burden and carries it about (unnoticed). When she grows heavy, they both pray to Allah their Lord, (saying): If Thou givest us a goodly child, we vow we shall (ever) be grateful. (Qur’an, 7: 189)

Another teacher, C, agreed with teacher A:

My main problem with science is the issue of Creation. I do believe as a Muslim that God creates everything. That is why I don’t believe in science so much. For me, Islam encourages science and research in science. But science itself conflicts with Islam. That might mean that science is concerned just with material things while religions such as Islam are concerned with everything as well as the material and how we use it.

Another aspect of the conflict was the source of the truth: teachers viewed truth as not based in science but on the Qur’an. For example, teacher C commented:

I don’t agree with the scientific methods that claim that their results and measures are one hundred percent accurate and the consequences of that belief. I do believe in Islam and the reality of Islam.

Most of the teachers saw a conflict between science and religion, and accused scientists, especially Western scientists, of not understanding religion. For example, teacher B said:

Of course, there is to some extent a conflict between science and the Islamic religion. It’s nothing to do with Islam as a religion, but is to do with scientific thinking which works without any consideration of any ethical perspectives or for the consequences for humanity.

Independence with Religion Dominant

Only ten respondents to the questionnaire (13.3%) agreed that science and religion should be kept separate because their aims and methods were different. These ten teachers viewed science and religion as having an independent relationship, seeing them as two independent disciplines. Each was asking a distinctive type of question, employing distinctive methods and serving distinctive functions in human life.

Teacher D also highlighted his lack of knowledge about the relationship between science and religion:

I do not have enough knowledge about that kind of relationship; however, for me science and religion are two faces of one coin, as both of them give us different information. Science gives us scientific details and religion gives us values, morals and ethical beliefs.

Teacher E agreed with teacher D about the separation between science and religion while maintaining the idea of the supremacy of religion:

I think science and religion are separate issues, however, religion should be the dominant power when we think about science. We can study whatever we need to study in science, but religion at the end is the evaluating factor in whether to accept the application of this scientific work or not. This is because religion has responsibility for the moral and ethical aspects (of life) and religion is the organizer of people’s lives.
Dialogue under the Authority of Religion

As shown in Table III, a significant number of the teachers (14 or 18.7%) who responded to the questionnaire represented the ‘dialogue’ view. These teachers advocated a dialogic relationship between science and religion, believed that science by itself was limited and could not answer all the questions, and that religion could suggest possible answers to such questions. This group emphasized that there should be a strong and close relationship between science and religion because religion gives guidance that science seeks to attain. They also expressed the view that the more science moved towards religion, the more successful science would be in benefiting humankind.

They stressed that the distinction between science and religion should be maintained, but that thoughtful dialogue can occur. For teacher G, religion should have authority over science:

The relationship between science and religion is a strong and firm one; because without religion there is no science. Qur’anic verses stimulate and encourage us to learn, and noble Hadiths show us how to pay attention to science and relate it to religion because there are issues that cannot be applied except after coming back to religion.

Teacher I agreed with teacher G in regarding science as a servant to religion. She commented:

Science is a means of understanding what religion advises us to do and the reason behind this advice. I don’t think that religion is complementary to science since what the latter teaches (proves) is there in the Holy Qur’an and Sunnah; science comes only to explain what seems obscure or unrecognizable.

Integration with Science as Part of the Islamic Body

In contrast to the conflict and independence views, there was a significant majority (46 teachers or 61.3%) who responded to the questionnaire and expressed the integration view of the relationship between science and religion. This group argued that religions, especially Islam, ask us to seek learning. They also argued that science can prove religious beliefs which we absolutely believe in, even though they are not interpreted scientifically.

Most of the teachers who held the belief that there was an integration relationship between science and religion viewed science as a part of God’s creation, so there was no conflict at all. Teacher M gave an example of this integration when she said:

The scientist is required to explain and verify some phenomena that are mentioned in religion.
Religion demands that scientists search and think of every phenomenon.

In contrast with dialogue ideas about the dominance of religion in communications between scientists and religious scholars, teacher K expressed the view that such communication should be based on respect and equality:

Religious explanation mustn’t be discarded. On the contrary, it must be respected [taken into account] and men of religion should discuss it with men of physical science in an endeavour to convince them. This can happen on one condition: all of them should be open-minded and accept the others’ views without rigidity.

All of the teachers who thought about the integration between science and religion emphasized that the religious description of any scientific phenomenon should not be excluded; it had, on the contrary, to be taken into account. For example, teacher N, a biology teacher, said:

Science affects my faith, because the more man goes deeper into science the more he grows aware of things around and the more he knows about the power of Allah, who can never be disabled by anything in earth or heavens. Consequently, this will affect how much man is religious.

Teacher J, a preparatory school science teacher, mentioned the need for science to be objective towards religion, pointing out that:
Scientific knowledge must be connected with religious knowledge for overall knowledge to be objective, because religious principles show science the right path and the right science asserts the concepts of religion.

Secondary school physics teacher N also mentioned ‘cause and effect’ as an example of the integration between religion and science, when she said:

the scientific phenomenon that can be described in light of cause and effect can never conflict with the religious description. Sometimes we have to mention the scientific description only and just hint at the religious description. We also show there is no conflict in between; for example, when we handle the concept of ‘shooting stars’ (meteors) we see that science shows how they evolve whereas the religious description clarifies the reason behind this evolution.

All the teachers held an integration view of science and religion, and saw science and religion as a unity and complementing each other. They are two sides of one coin and there is no discrepancy between them. For example, as teacher L said:

Religion calls for science and scientific research and this is clear in a lot of the Holy Qur’anic verses. So religion and science are not dichotomous. So, science must always be related to religion.

Teachers’ Pedagogical Beliefs about Science and Religion

Most of the teachers mentioned that whenever necessary they used examples from the Holy Qur’an. For instance, they often used Qur’anic verses to introduce lessons from Unit 1 (‘Outer Space, Planets and Stars’) in the preparatory-level book entitled You and Science. For example, in Lesson 1 (‘Near and Far: the universe and space’), the lesson is introduced with this verse:

It is We Who have set out the zodiacal signs in the heavens, and made them fair-seeming to (all) beholders. (Qur’an, 15: 16)

In Lesson 2 (‘The Motion of the Moon’), the two following verses are used to introduce the lesson:

It is He Who made the sun to be a shining glory and the moon to be a light (of beauty), and measured out stages for her, that ye might know the number of years and the count (of time). Nowise did Allah create this but in truth and righteousness. (Thus) doth He explain His Signs in detail, for those who understand. (Qur’an, 10: 5)

And the Moon, We have measured for her mansions (to traverse) till she returns like the old (and withered) lower part of a date-stalk. (Qur’an, 36: 39)

In Lesson 3 (‘Rotation of the Sun’), the lesson is introduced by this verse:

And the sun runs his course for a period determined for him: that is the decree of (Him), the Exalted in Might, the All-Knowing. (Qur’an, 36: 38)

In Lesson 4 (‘Solar and Lunar’), there are three verses which introduce the lesson:

At length, when the sight is dazed. (Qur’an, 75: 7)

And the moon is buried in darkness. (Qur’an, 75: 8)

And the sun and moon are joined together. (Qur’an, 75: 9)

Among the science teachers, around 33% of the respondents to the questionnaire (see Table III) expressed the view that science teaching makes one more attached to religion through such natural phenomena as solar and lunar eclipses, the alternation of day and night, photosynthesis and the way it purifies air and provides it with oxygen, and gravity and its effect on rainfall.

Teacher B expressed a religious approach to teaching science and religion, saying:

Teaching science should be connected to religion. An example of issues that provide a context for this is the creation of man and the development of the embryo. When I teach this issue I always present these verses.

The verses cited in support of this were the following:
We created you out of dust, then out of sperm, then out of a leech-like clot, then from a morsel of flesh, partly formed and partly unformed ... and We cause whom We will to rest in the wombs for an appointed term, then do We bring you out as babes. (Qur’an, 2: 5)

We placed him as (a drop of) sperm (nutfah) in a place of rest, firmly fixed; then We made the sperm into a clot of congealed blood (alaqa); then out of that clot We made a (foetus) lump (mudghah), then We made out of that lump bones and clothed the bones with flesh; then We developed out of it another creature. (Qur’an 23: 13-14)

Twenty-seven percent of the questionnaire respondents preferred the religio-scientific approach based on presenting controversial religio-scientific issues from Islamic-scientific world views, with an emphasis on religious views. The key aim of this approach, as expressed by teacher L, is to achieve the scientific aims of the subject of science by discussing how some scientific issues are related to religion and how some can be refused (such as Darwin’s theory of evolution which does not agree with Islam).

Teacher L, who had an integrationist view, said:

Religion affects my dealing (handling, understanding) with scientific concepts, for example, in talking about the phenomenon of the aurora (evening twilight) which is mentioned in a verse in the Holy Qur’an. Consequently, when teaching students a phenomenon like that we get help from the Holy Qur’an.

Teacher B commented, from a conflict viewpoint:

Theories are changed; and one replaces another; thus Einstein’s quantum theory replaced Newton’s classical theory. This is the way we should teach science to students, as a kind of interpretation or as a pathway towards understanding nature. Scientists try to create models for understanding our nature, but they may get this right or wrong. Regardless of this, we should respect them for doing their best. However, the absolute truth is in religion.

An example from a dialogue point of view was teacher G, who said:

I do not believe in evolution theory or the cloning issue, but I teach them in combination with showing students the difference between them and what is stated in religion. I also review the Qur’an with the students because there has to be truthfulness in all fields to convey something to them: all these theories can be mistaken.

Teacher D was an example of an independence viewpoint:

I don’t believe in evolution theory or the cloning issue, but I teach it to clarify the right and the wrong aspects. Also, in studying the concept of creation we remind students of the verses of Allah that show He creates everything.

Discussion

The Relationship between Science and Religion

In the literature about science and religion, there are different ways of understanding the relationship between the two (see, for example, Davies, 1983, 1992; Barbour, 2000; Luskin, 2004; Stolberg, 2007). Davies (1983), for example, argues that science and religion represent two great systems of human thought. For the majority of people, religion is the predominant influence in the conduct of their affairs. However, science, too, influences people’s lives through technology. Davies’ argument partly explains why science teachers saw a conflict between science and religion. As teacher B noted: ‘I do think, but I am not sure, that there are a lot of applications in genetic engineering that conflict with religion because it alters the creation of God in plants or animals’.

Barbour (2000) categorizes the relationship between science and religion as being one of conflict, independence, dialogue or integration. Barbour’s categories better serve the purposes of the current study, whose aim was to investigate the range of views among science teachers of the relationship between science and religion. Barbour describes the possible relationships between science and religion as follows.
Conflict. Barbour reports that he grouped the two extremes, 'Science & Religion', within the same group category of conflict:

a pairing that may at first seem strange. I do this because scientific materialism and biblical literalism both claim that science and religion make rival literal statements about the same domain, 'the history of nature', so a person must choose between them. (Barbour, 2000, p. 11)

In the current study, teachers viewed any conflict between science and religion not as 'religion conflicting with science', but as 'science conflicting with religion'.

Teachers’ views of the conflict are based not on a separation between scientific materialism and Qur'anic literalism, but on understanding and respect towards science from the Islamic, religious side, and on conflict and ignorance over religious values and morals from the science side. In this respect, Al-Hayani (2005, p. 566) argues that 'the base of the disagreement between science and religion is the notion that science is a secular pursuit driven and guided by worldly needs and gratifications, without an ethical or religious base to guide these pursuits'. However, from the teachers’ point of view, the key conflict between Islam and science was about the reality of the origin of the universe. For example, teacher C said: 'My main problem with science is the issue of Creation. I do believe as a Muslim that God creates everything. That is why I don’t believe in science so much.' In this respect, Strassberg (2001) argues that some people might see conflict between religion and science on the level of knowledge (creation and the big bang), but appreciate the contact between them at the level of norms (religion reinforcing the legal system).

Science teachers, like any Muslims in the Islamic world at large, base their beliefs (aqida) on the claim that God is the creator of everything. Elements of the creation story are found throughout the Qur’an; some are expressed more than once and in different ways. In the Qur’an, God says:

Who made good everything that He has created, and He began the creation of man from dust. Then He made his progeny of an extract, of water held in light estimation. Then He made him complete and breathed into him of His spirit, and made for you the ears and the eyes and the hearts; little is it that you give thanks. (Qur’an, 32: 7-9)

Independence.

Science and religion can be distinguished according to the questions they ask, the domains to which they refer, and the methods they employ. (Barbour, 2000, p. 17) Some of the science teachers in this study expressed an independent view of the relationship between religion and science that agrees with Barbour’s statement. This view is not quite in line with the Islamic epistemology of knowledge, which encourages the gaining of knowledge in different fields of science and with different research methods. In the history of Islamic sciences, there are three sources for the acquisition of knowledge: reason, experience and the evidence of transmission from a reliable source.

Ahmed (1999) argues that when we become skilled at testing these sources of knowledge against one another, then we know that we are coming closer to the truth. The Qur’an offers high praise of all three of these sources of knowledge. It praises reason and repeatedly condemns the polytheists for their adherence to ideas that contradict their intellectual sense. The Qur’an insists:

Do they not look at the sky above them? How We have made it and adorned it, and there are no flaws in it? (Qur’an, 50: 6)

No want of proportion wilt thou see in the creation of (God) Most Gracious. So turn thy vision again: Seest thou any flaw? (Qur’an, 67: 3)

The Islamic view of science and research in science matches modern scientific works with what some call ‘the scientific method’ and others call ‘inductive science’ or ‘inductive reasoning’. The idea is that our reason must match our observation and that our theories must be tested by our experiments; there is a great cycle in which theories inspired by observations are tested by experiments that lead to refined theories that are to be further refined or overthrown by yet more experimentation or observation (Ahmed, 1999).
Religious Beliefs and Science Teachers

Dialogue.

One form of the dialogue is a comparison of the methods of the two fields, which may show similarities even when the differences are acknowledged. Dialogue may arise when science raises at its boundaries’ limit questions that it cannot itself answer. Also, dialogue occurs when concepts from science are used as analogies for talking about God’s relation to the world. (Barbour, 2000, pp. 2-3)

Science teachers’ understanding of the dialogue between science and religion was based on their understanding that science needs religion to guide it, control it and alert people to its dangers. They also expressed views on the dominant role of religion in scientific research. This understanding of the dialogue relationship between science and religion arose from teachers’ understanding that religion should have authority in science. This viewpoint on the part of science teachers can be explained by comprehending their understanding of the ontological position of Islam regarding science, as I will discuss later.

Integration.

Proponents of the integration thesis seek a closer correlation of particular religious beliefs with particular scientific theories than is advocated by exponents of dialogue ... A theology of nature is represented here by models of God as Creator that express the central beliefs of religious community but incorporate theological reformulations in response to current cosmology. (Barbour, 2000, p. 57)

Barbour’s contention supported the findings of this study that the majority of the teachers believed there was an integration relationship between science and religion. They viewed God as the creator of everything but also viewed science as a part of God’s creation. So, there was no conflict at all. In contrast with dialogue ideas about the dominance of religion in communications between scientists and religious scholars, teachers considered that such communication should be based on respect and equality.

Teachers also viewed science and religion as a unity, and considered that they complemented each other. They were two sides of one coin and there was no discrepancy between them. The Arabic word īlm and its derivatives are frequently used in the Qur’an. It means ‘knowledge’ in its general sense, including the sciences of nature and the humanities. With this perspective there is, epistemologically, no separation of religious sciences and secular sciences, and no dichotomy or dualism – the only thing that exists is categories (Yahya, 2005).

Teachers’ Views of Science and Religion and their Pedagogical Beliefs

The results of this study indicated that teachers’ views about science and religion influenced their views of teaching science and religion. These results accord with previous research indicating how teachers with different ways of relating science and religion teach science by using different approaches that fit their beliefs about science and religion (Jackson et al, 1995; Cobern & Loving, 2002; Stolberg, 2007). In this respect, Reiss (2004) argues that within a particular society there are certain characteristics among individuals (such as gender, religious beliefs, ethnicity, age and disability) that cause them to differ in their scientific understanding and conception of the world. Reiss also considers that a teacher has a positive role in responding to the interaction between interindividual and intercultural differences in scientific understanding and practices.

This study also agrees with the work of Nyhof-Young (2000) and Stolberg (2007), who found that teachers’ views about science and religion governed their own roles and approaches in classroom teaching, and concurs with Dagher & BouJaoude (1997, p. 440) that ‘combined beliefs about religion (among other things) and about science strongly influence how students evaluate evidence for evolutionary theory by delimiting what counts as evidence and eventually interfering with understanding the theory’.

Similarly, its findings agree with others (for example, Lortie, 1975; Shulman, 1987; Grossman, 1989; Mansour, 2006, 2008) who claim that teachers’ pedagogical beliefs are shaped by experiences that act as a filter for new experiences. These, in turn, also make teachers behave in a certain manner. Beliefs are often held to be derived from one’s personal life history and from cultural
socialization (Enyedy et al., 2006). In this respect, the study concurs with Oser & Althof (1993), who conducted an in-depth biographical study on the processes and conditions that result in specific variations of professional morality. The surveyed teachers reported that various experiences and the reflections these generated eventually led to changes in their ethical orientations.

Some interviewees in the present study felt that the current science curriculum reflected a ‘monoculture’ – i.e. Western culture rather than their Arab culture. They remarked that the curriculum was focused on the development of science by Western scientists, and that this might negatively affect the students’ identities and their attitudes towards learning science or taking up careers in science. In this respect, Reiss (1993, p. 70) mentions that ‘when science is put in an historical context in school, that context is often biased, with the work of white scientists being overrepresented’. Therefore, there is a need for the curriculum developer to think about what Reiss calls ‘multicultural science’, within which pupils can be helped to see that science is a cultural activity, and it is inevitable that different cultures will produce different sciences (Reiss, 2000). Furthermore, he argues that science education should be universal and encourage students to wonder about the natural world and to shape their own scientific thinking. He concludes that these aims can be achieved by the full adoption of a multicultural and anti-racist perspective on science.

Stanley & Brickhouse (2001) also emphasize the universalists’ argument for an all-inclusive view of science, pointing out that Western modern science (WMS) provides a superior knowledge of the natural world, compared with premodern European thought or the ‘folk thought’, ‘ethnosciences’ and other less creditable forms of knowledge held by non-Western cultures. In light of the current study’s findings that some science teachers have negative attitudes toward Western science, we, as teacher educators, should not simply focus our efforts on the question of what kind of science (WMS and/or local ‘ethnic’ science) to teach to indigenous or religious people whose world views are distinctly different from mainstream Western ones (Stanley & Brickhouse, 2001), but should also focus on how WMS is presented to both teachers and students. Questions should also be asked about the standards of the WMS included in science curricula and how WMS should be balanced with the Islamic sciences. In this respect, Nyhof-Young (2000, p. 451) argues that as educators, it is our key role to develop and adapt curricula to fit our knowledge, priorities and unique teaching contexts.

Implications
Science curricula should present different views about science and religion, and should also question the notion that there is a conflict between science and religion in order to show the false contradiction between science and religion. As Hefner (2002, p. 59) notes, this can be achieved by arguing the reasons for this false conflict on three counts. First, science has come to a point where its methods of seeking knowledge and truth differ substantially from those of religion. Second, in the two quests for truth, the uses of language and concepts also differ. Third, both science and religion have been co-opted by societal and cultural forces whose differing interests tend to accentuate the conflict between science and religion. Thus, our role as science teacher educators is to make our teachers gain more awareness of the uses of language, the differences between scientific and religious language, and the nature of archaic expressions of meaning.

Science teacher education should train teachers in the way scientific and religious perspectives fit together (Katz, 2002), since science teachers should recognize the reciprocal relationship between science and religion. Science should acknowledge the human need for religious experience, and religion needs to recognize and trust the desirability of having greater scientifically based knowledge about people’s lives and their environment. There does not need to be any conflict between these domains: science is a human process and religion explains what keeps and makes us human (Katz, 2002). In this regard, Bausor & Poole (2002, p. 31) suggest three ways in which science teacher education can help in teaching issues of science and religion: (1) by offering courses; (2) by offering help to providers of initial teacher education in covering such issues; (3) by producing written and other materials detailing the main points aimed at helping science teachers to address some of the spiritual/religious factors in science teaching.

It needs to be acknowledged that religious ideas and attitudes themselves are also involved as objects of research and reflection. Therefore, theology and science then move on to become a
‘science of religion’, or at least of religion in the light of the sciences (Drees, 2004). At the same time, teacher educators have to be aware of the personal views about science and religion that, in part, direct teachers’ pedagogical beliefs and practices (Jackson et al, 1995; Cobern, 2000; Cobern & Loving, 2002; Mansour, 2008). In this respect, argues Nyhof-Young (2000, p. 442), ‘our behaviours, beliefs, and attitudes, our preparation in science and religion, and the support we receive to promote and teach our courses have an important influence on student outcomes’.

As a result of dealing with science teachers who hold widely differing views about science and religion, many students will perceive science as being completely disconnected from the bigger issues of their life and their faith. Worse still, some students may perceive the science being taught as an attempt by the teacher to promote a particular truth or belief, or as an attack on their own faith. Here, the key question is: ‘What can a science educator do about all these conflicting voices?’

It is helpful to look at what sort of world-view assumptions are necessary to serve as a base for doing science. This base can combine the philosophy of science and the religious view of science. Scientific and religious ideas always have philosophical, cultural and historical contexts; thus, any true understanding of the relationship between science and religion will take such broader contexts into account. Understanding these contexts will also provide a basis for evaluating all the conflicting claims about science and religion. It will be possible, for instance, to see that the relationship between science and Islam is neither aggressive nor confused, and that, in fact, Islam provides both a powerful motive for doing science and a strong philosophical understanding as to why the scientific method works.

Science teachers will encounter legitimate opposition from individuals with a religious perspective (Jackson et al, 1995), and while scientific content can offer a great opportunity for developing critical thinking around the process of science, it should not stop one from delivering values, morals and ethics. By contrast, the need to acquire values, morals and ethics becomes much more important, especially when one is dealing with controversial issues related to people’s lives, religion, history, thoughts and beliefs. Students are taught what scientific knowledge means, how this knowledge is gained, how scientists think, what they take into account when developing scientific theory, and how scientists from different backgrounds and contexts negotiate their theories. By doing this, science teachers can be liberated from their own personal beliefs. In this respect, Loo (2001, p. 71) argues that science education should concern itself with the teaching of scientific knowledge. The epistemology of science is not as objective as it appears. Since science is a branch of knowledge generated by human beings, scientific inquiry is a humanistic process that is not founded solely on the cornerstone of reason. Stanley & Brickhouse (2001, p. 42) argue that our sciences are human sciences, and that reality – whatever we make of it – is an artefact of the consensual practices of viable human communities; for this reason it is not ‘brute’ and not ‘external’ (see Margolis, 1995, p. 17).

Science teacher education should therefore prepare teachers to be scientifically and religiously knowledgeable, so that they can argue any issue both scientifically and religiously, based on supported evidence. Within our understanding of the concept of ‘global citizenship’, it is necessary to think how science and religion are going to be presented to pupils in a classroom that is multicultural in terms of religions (for example, Muslims, Christians, etc.). Science must be delivered to all our students as our future citizens. In this respect, I do agree strongly with Loving & Foster (2000, p. 446) that today’s science teachers are confronted with the daunting challenge of ensuring science literacy for all students. Students should emerge from schools with a better understanding of the nature of science and how it proceeds. Meeting this challenge requires a comprehensive understanding of science as a discipline.

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