

Science teachers' interpretations of Islamic culture related to science education versus the Islamic epistemology and ontology of science

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Received: 5 May 2009 / Accepted: 5 May 2009 / Published online: 26 May 2009
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Abstract The debate about Islam and science extends to a debate about the relationship between Islam and science education. In this paper, I explore Egyptian teachers' views of the relationship between science and religion within the Islamic context. Teachers' key vision of the relationship between science and religion was that "religion comes first and science comes next. I will argue that teachers' personal religious beliefs are among the major constructs that drive teachers' ways of thinking and interpretation of scientific issues related with religion. Then, I discuss how teachers' personal religious beliefs have been formed and influenced their pedagogical beliefs related to science and religion issues. Finally, I will argue, how we use the personal religious beliefs model as a framework of teaching/learning scientific issues related with religion within sociocultural (Islamic) context.

Keywords Personal religious beliefs · Religious schema · Islamic epistemology of science sociocultural context

تُعد العديد من موضوعات التربية العلمية مثل؛ نشأة الكون، الهندسة الوراثية، الاستنساخ، الاجهاض،.... ألخ قضايا جدلية مما يجعلها تسبب تحدياً لمدرسي العلوم وخصوصاً في الثقافات الدينية وخصوصاً الثقافة الإسلامية، وهذا قد يرجع لطبيعة التعارض بين تطبيقات بعض تلك القضايا العلمية والدين الإسلامي. كما أن هناك قضايا وإكتشافات علمية لا تتعارض على الإطلاق مع الدين الإسلامي، إلا أن وجهات نظر المعلمين او الطريقة التي يفسرون بها وجهة نظر الدين للعلم قد تسبب هذا التعارض الظاهري.

تتناول هذه الدراسة وجهات نظر مدرسي العلوم المصريين للعلاقة بين العلم والدين ومدى اتفاق وجهات نظرهم مع نظرة الدين الإسلامي للعلم. كما تتناول الدراسة أيضاً مدى تأثير ممارسات ومعتقدات المدرسين التربوية بفهمهم لنظرة الدين الإسلامي للعلم.

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تميز الدراسة الحالية بين مفهوم "المعتقدات الدينية الشخصية"

"Personal Religious Beliefs PRB" و بين مفهوم "المعتقدات الدينية" "Religious Beliefs RB"

فتعرف المعتقدات الدينية بأنها المعتقدات القائمة على الفهم الصحيح للدين الاسلامي والقائمة على التفسير الصحيح للقرآن والاحاديث النبوية. بينما تُعرف الدراسة الحالية "المعتقدات الدينية الشخصية" على انها مجموعة وجهات النظر، والآراء، والاتجاهات، والمعرفة التي يكونها الفرد بتفاعله مع بيئته الثقافية والاجتماعية والتي يعتقد الفرد بأن لها أصول دينية. بالإضافة ان "المعتقدات الدينية الشخصية" تمثل وجهة النظر القائمة على إجتهد شخصي لنظرة الدين للعلم، تلك الواجهة الشخصية قد تُخطىء وقد تُصيب في فهمها وتفسيرها للمنظور الاسلامي للقضية الجدلية/العلمية. تلك المعتقدات الدينية الشخصية يستخدمها الفرد كأطار مرجعي لفهم الاحداث والخبرات التي تواجهه في حياته ومعاملاته مع الآخرين. وتؤكد الدراسة أن تلك المعتقدات الدينية الشخصية ما هي إلا مكون اجتماعي يختلف من فرد لآخر، وانها تتكون نتيجة مجموعة من الخبرات المتفاعلة والمتركمة التي تواجه الفرد وان اقوى تلك الخبرات تأثيراً هي الخبرات الدينية.

كما شرحت الدراسة كيفية تكوين "المعتقدات الدينية الشخصية" للمعلمين نتيجة تفاعله مع بيئته الثقافية الاجتماعية. وكيف تؤثر تلك المعتقدات على ممارسات ومعتقدات المعلمين التربوية. هذا وتعرض الدراسة نموذج المعتقدات الدينية الشخصية لتفسير كيف يؤثر تأويل الفرد للحدث أو الخبرة الدينية على اكتسابه لخبرة أو معرفة علمية جديدة. كما يفسر النموذج تأثير المعتقدات الدينية الشخصية على تشكيل المعتقدات التربوية والممارسات التدريسية داخل الصف الدراسي للمفاهيم والموضوعات العلمية التي يكون لها ارتباط بخبرات دينية والتي تكون طبيعتها جدلية.

ولقد اوضحت نتائج الدراسة ان وجهات نظر المعلمين حول العلاقة بين العلم والدين تدور حول اربعة وجهات نظر متداخلة ومتباينة فيما بينها:

- تضارب " من جانب العلم"، هذا ويتركز التضارب على تفسير نشأة الكون (نظرية الخلق مقابل نظرية التطور).
- استقلال "مع تغليب رأي الدين"، حيث يرى بعض المدرسين ان العلم والدين يمتلكان نظم فكرية وبحثية مختلفة ومستقلة.
- حوار "مع اتباع الرؤية الدينية"، حيث يرى المدرسين ان العلم محدود ولايستطيع الاستجابة للتحديات العلمية بمفرده وانه بحاجة الى دعم وإرشاد ديني.
- تكامل "كجزء من البناء الاسلامي"، تكشف هذه الرؤية عن ان الدين الاسلامي يشجع على العلم والبحث العلمي لخدمة البشرية وان العلم والدين يمثلان وحدة متكاملة.

كما اوضحت الدراسة تضارب بين وجهة نظر المعلمين و وجهة نظرة الدين الاسلامي حول العلوم المكتشفة على أيدي علماء غرب أو علماء غير مسلمين. حيث يمتلك بعض المدرسين اتجاه سلبي تجاه العلوم المكتشفة على أيدي علماء أجنب غير مسلمين. في الوقت الذي يُشجع فيه الدين الاسلامي على تحري العلم النافع من اي مصدر سواء إسلامي أو غير إسلامي. وفي هذا السياق تناقش الدراسة التعارض بين المعتقدات الدينية الشخصية والمعتقدات الدينية في مناقشة القضايا العلمية الجدلية وكيف يمكن التعامل مع او التغلب على هذا التعارض من خلال خبرات تربوية منظمة.

هذا وقد اوضحت الدراسة ان المعتقدات الدينية الشخصية للمدرسين انعكست على رؤيتهم لمنهج العلوم ومحتواه. فينقد بعض المدرسين منهج العلوم الحالي بأنه يعكس ثقافة وحيدة وهي الثقافة العلمية الغربية ويتجاهل الثقافة العلمية العربية. ويرى بعض المدرسين ان التركيز على تدريس العلوم الغربية فقط قد تؤثر سلبياً على هوية الطلاب وعلى اتجاهاتهم نحو دراسة العلوم أو نحو العمل في المجال العلمي في المستقبل.

وأخيراً أوضحت الدراسة أهمية الاخذ في الاعتبار التفاعل المستمر ما بين السياق الثقافي والاجتماعي الذي يعيش فيه الفرد/المعلم وبين معتقداته الدينية الشخصية عند وضع برامج لتعليم وتعلم القضايا العلمية والتي يكون لها بعد ديني. وأنه من المهم مراجعة وفحص تلك المعتقدات بشكل دوري منتظم على إفتراض أنه مع التطور التكنولوجي وظهور اكتشافات علمية جديدة ستظهر قضايا جدلية جديدة والتي ستستلزم التعامل معها بشكل تربوي مقصود ومنظم.

This paper is based on the findings of a series of research studies that I carried out in this area “religious beliefs and science Education” with Egyptian science teachers. I begin with a brief representation of Science teachers’ views of science and religion (part one). Then I explained how these views influence teachers’ pedagogical beliefs (part two). In part three, the paper explains how teachers’ interpretations of Islamic context related to knowledge and science form their negative attitude toward non-Muslim western sciences. This is followed by the Islamic perspective of the nature of science (part four). The last part explains the processing of teachers’ religious experiences and their pedagogical beliefs within Socio-Islamic contexts (part five).

Definition of personal religious belief (PRB)

This paper is based on a term called “Personal Religious Belief (PRB).” This term is used on this paper to refer to the views, opinions, attitudes, and knowledge constructed by a person through interaction with his/her sociocultural 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 products of the interactions

among all the experiences that the person accumulates, and depend on the sociocultural context in which the individual has been brought up, this study adopted sociocultural constructivism as its theoretical framework.

Part one: Egyptian science teachers' views of science and religion

Teachers' views about science and religion are overlapped and allied to form and confirm the centrality of teachers' personal religious beliefs on their thoughts and views concerning science and religion issues. These views fall in four groups that included "conflict from the science side," *independence* with religious dominant, *dialogue* under the authority of religion, and *integration with science* as part of an Islamic body. These views highlight teachers' key vision that "religion comes first and science comes next." Examples of teachers' quotes of these four groups are:

Conflict from the "science" side

Evolution against 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. What I understand that as comes on the holy Qur'an that our first ancestor was the Adam (upon whom be peace), who was created by Allah in *janna* [paradise] and not on earth.

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."

Independence from the religious dominance

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. For example, Teacher D commented, "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 C 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 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

Under this group, teachers 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 was maintained, but that thoughtful dialogue can occur. For example, 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 H emphasized the communication relationship between religious scientists and religious secularists. He said, "The relation of science to religion is dialectic because scientists sometimes cannot have the only (sole) right to take a decision until they give and take; give and take with specialized scientists and men of religion and *shari'a* (legislation)."

Integration with science as part of Islamic body

In contrast to the conflict and independence views, there was a significant majority 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. 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 endeavor to convince them. This can happen on one condition: all of them should be open-minded and accept the other's views without rigidity.

All 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."

All teachers hold an integration view of science and religion, and see science and religion as a unity and complementing each other. They are two sides of one coin and there is no discrepancy between them. Thus, teacher T suggested, "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.”

Part two: matching of science teachers' views about science and religion with their pedagogical beliefs

Teachers with different views of the relationship between science and religion (conflict, dialogue, independence, integration), teach science by using different approaches that fit their views about science and religion. Examples of teachers' pedagogical beliefs related to their views about science and religion include 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.

Another point of view stresses *dialogue*, as apparent in teacher G's comment:

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 expressed an *independence* viewpoint in saying “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.” One teacher talked in ways that represented an *integrationist* view when he 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.”

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 inter-individual and inter-cultural differences in scientific understanding and practices. Other research found that teachers' views about science and religion governed their own roles and approaches in classroom teaching, which concurs with the statement 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” (Dagher and BouJaoude 1997, p. 448).

The analyses of the interviews I carried out with Egyptian science teachers revealed that they had been left to their own interpretations in dealing with the lessons that related science to religion. In the absence of any guidance from the Ministry of Education, they felt that they were trapped by unexplained Qur'anic verses that introduced the lessons, since the scientific meaning of the verses was not included within the scientific content of the lessons. Further, because support was absent in teacher education where the

relationship between science and religion was concerned, teachers obtained their knowledge from informal sources.

Teachers expressed very strong beliefs—the key religious belief on Islamic world-views—that the Qur'an was a book for guidance, not just for scientists but for all humankind in all aspects of life, including how man should seek scientific empirical knowledge, what method he should use and what ethics he should follow. This explains why science teachers used a dominant-religious argument to support their views of the relationship between science and religion. Most of the arguments they put forward were based on religious evidence or just on logical thinking without any scientific evidence.

Part three: teachers' interpretation of Islamic epistemology toward non-Muslim western sciences

Egyptian teachers held negative attitudes about some kind of science merely because this form of knowledge had been invented by non-Muslims. For example, Teacher C said, "We should not take any knowledge from any non-Muslim scientist. Their science will be useless for our society and will do us harm more than benefiting our society. Look at cloning, or at the ideas of genetic engineering, which have caused the transfer of many diseases." Teachers thereby are not quite in line with the Islamic epistemology of knowledge, which encourages the gaining of knowledge from everywhere at any time. Islamic teachings have encouraged Muslim people to exceed their previous visions of technological and scientific narrow confines. Therefore, wherever knowledge came, a Muslim could receive it. This approach helped Muslims obtain various sciences and technologies from other civilization like Greece, China, and India, even though the religions were different. The translation of classical science, philosophy, and humanistic-social science was one of the primary vehicles of Islamic assimilation of alien science and technology.

In this respect, one should mention the well-known *hadith* (saying of the Prophet) that advises the individual "to seek knowledge even in China," and which thus directly invites learning and the gaining of knowledge from a non-Muslim country. What knowledge was available in China at the time of the Prophet? Certainly there could not have been more knowledge about Islam than there was in Mecca and Madina and in Arabia where Islam had its origins. The knowledge that could be acquired in China would have been non-religious knowledge, since China at that time was already advanced in papermaking, ceramics, explosives, and the arts of administration and of war. Clearly Islam also wants Muslims to learn about subjects that are not specifically linked to religion, even if the source of knowledge is not Muslim. In this regard, Kamali (2003) argues that the Prophet Mohamed could not have considered knowledge as an extension, or even a concomitant, of the beliefs, *aqida*, of Islam. The author also maintains that the Prophet's saying takes a pragmatic and utilitarian view of knowledge, which can be sought outside Islam if necessity demands it. Here, the great and underlying message from the *hadith* is that a Muslim's loyalty and commitment to Islam is unaffected by his or her attempt to seek knowledge from a non-Islamic source. Knowledge obtained from non-Islamic sources may not be "rooted in God" or necessarily lead to Him.

The attitude of Muslim science teachers towards non-Islamic western science reflects part of the Islamic epistemology of science. This epistemology is based on Islam's perception of knowledge, as it is value-oriented and informed by ethical and theological concerns. In contrast, western science has no place for religion. Kamali argues, in this

connection, that this epistemology leads to a basic pattern of harmony, rather than conflict, between Islam, and science. Any revitalization of Islamic science will therefore require the critical integration of modern Western knowledge into the new Islamic knowledge, just as the early Muslims freely evaluated numerous foreign bodies of knowledge. Today's Muslims have not yet demonstrated that they accept this. Instead, there is still an underlying feeling that everything in the West is bad and must be rejected completely. One Muslim can hurl no greater insult against another than by saying, "You have been influenced by the West." However, what might cause anti-Western sentiments about sciences in the Islamic context is when modern Western scientists make discoveries about the natural world and claim that their representations (e.g., hypotheses and theories) are telling us something about reality as it is in itself.

The problematic of Muslim science teachers with negative attitude toward western scientists can be explained in terms of teachers' personal religious beliefs. Teachers with these negative views ascribed to naïve views of the nature of science and they do not have a sense of how scientific knowledge is generated at the epistemological practical levels. In this respect, research has shown that teachers' views of the nature of science are not consistent with contemporary conceptions of the scientific endeavor. In this case, it is unlikely that teachers who subscribe to naïve conceptions of the nature of science would be able to help their students develop informed nature of science views.

Part four: Islamic perspective of the nature of science

Science is the study of the material, processes, and forces of the natural world. Science is not about belief; it is about how things work. Science is about the exploration of natural causes to explain natural phenomena. Science is empirical, which means that questions of truth are established through experimenting and testing. There are no absolutes in science; all issues are open to retesting and reconsideration. While, religion is about belief, meaning, and purpose. Religious truths are evaluated by an appeal to authority, by contextualization in history, by their philosophical coherence, even by their psychological and emotional resonance with life and experience.

In the Qur'anic view, God is the Creator and the Sustainer of the universe. He has created everything in measure and has decreed for it a telos. The creation is in truth, not for sport or vanity, and everything has a definite term (Qur'an, 21:16; 38:27; 44:38; 46:3). The Qur'an has made a distinction between the Creator, the design and the internal order of the created things on the one hand and their guidance on the other hand. The direction that everything follows is not a result of its internal order. Rather, it is something beyond its orderly structure. The Qur'an mentions a universal notion of purpose and direction for the created universe (Qur'an, 20:50; 87: 2–3). In the Qur'anic view, the study of nature is not for its own sake; rather, it is supposed to serve as a means of bringing one closer to God. The Muslim scientists of the past believed that God's wisdom is reflected in His creation. Similarly, the founders of modern science did not pursue the study of natural phenomena to understand nature per se or for the sake of their own gratification, but as a means of proximity to God.

The Islamic view and the received view of science share the same methodology, that is, they both involve experimentation, observation, and theoretical work. Their difference is in the underlying worldview that affects their outlook towards God, the cosmos, and humanity, and affects their decisions concerning the practical consequences of their scientific work. Contrary to what other scholars, I do not think that the commitment of

Muslim scientists to the Islamic worldview would preclude their equality as partners in the world scientific community. The history of the glorious Islamic civilization is a good witness to this claim. The Islamic conception of knowledge does not confine knowledge of reality to that obtained through experimentation and theoretical reasoning alone, and does not consider the scientific study of the world exhaustive. Rather, by accommodating revelation and intuition, it encompasses spiritual as well as physical aspects of humanity and the cosmos, and it claims that there is more to reality than meets the human eye.

Part five: the processing of teachers' religious experiences and their pedagogical beliefs within socio-Islamic contexts

In this section, I show how teachers' personal religious beliefs have been formed and influenced their pedagogical beliefs related to science and religion issues.

Knowledge and teachers' personal religious beliefs

The powerful influence of teachers' beliefs in general or teachers' personal religious beliefs in particular on gaining knowledge related to science or controversial issues was highlighted in my findings. However, the settled or developed teachers' beliefs "schema" acted as an information organizer and priority categorizer, and in turn controlled the way it could be used. In the interactions between knowledge and beliefs, the latter controlled the gaining of the former and former influenced the latter. This suggested that teachers needed to create their own knowledge through a process of interaction between their existing beliefs and knowledge base, and the new ideas with which they came into contact. A number of researchers suggested that increased content knowledge went hand in hand with increased confidence, while having knowledge about teaching carried its own kind of authority that had the potential to empower teachers (e.g., Dadds 1995). There is a reciprocal interaction between teachers' beliefs and knowledge on one hand, and between teachers' experience and knowledge on the other.

The classroom observations I carried out revealed that teachers' beliefs regarding their roles, students' roles, the aims of science, and their teaching methods were strongly shaped by personal religious beliefs derived from the values and instructions inherent in the religion. Teachers' personal religious beliefs worked as a "schema," defined as "a cognitive structure or mental representation containing organized, prior knowledge about a particular domain" (McIntosh 1995, p. 2). The author also noted that schemas are built in encounters with the social context and could be modified by experience.

The religious schemas of these teachers influence the way they perceive new experiences. Teachers arrange the elements of their social context to reflect the organization of their own personal religious beliefs or religious schemas. A teacher with personal religious beliefs or religious schemas is more likely to use a religious interpretation on experience than a teacher without such personal religious beliefs or religious schemas. Moreover, teachers with particular personal religious beliefs may understand the situation or the experience very differently from those without these. However, teachers also hold beliefs about themselves, the nature of science, the individual students, teaching and learning science and religion, the social context in which they live, the school environment in which they work, and the constraints they have to deal with. These beliefs, in turn, work through the lens of past experiences, since they are translated into teacher practices within the complex context of the classroom.

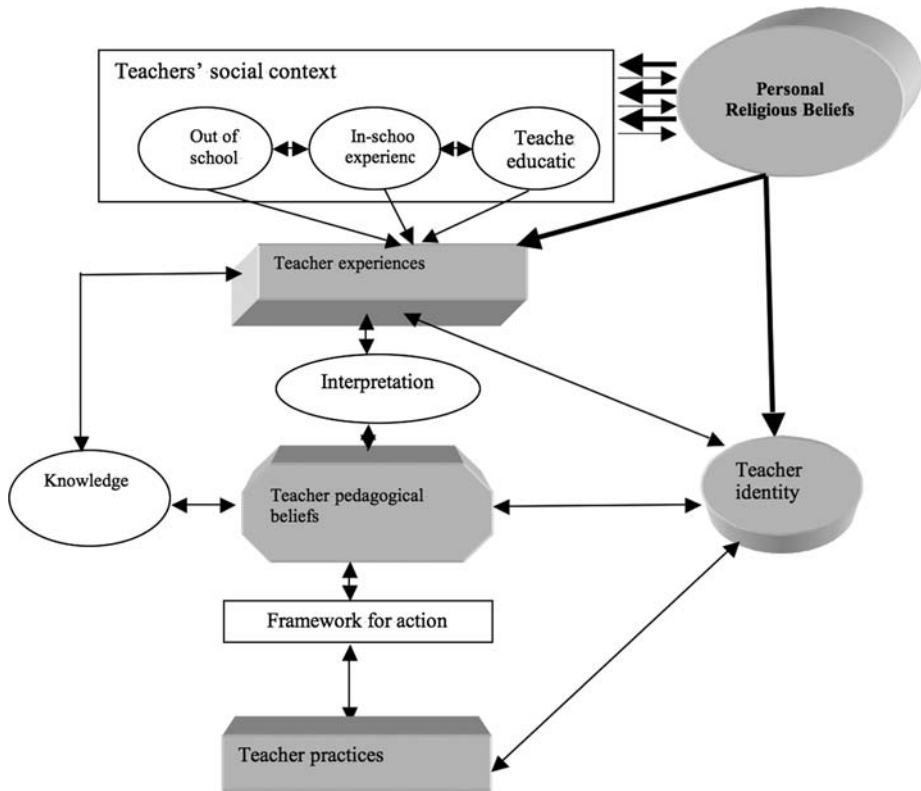


Fig. 1 Personal religious beliefs (PRB) model

Teachers' personal religious beliefs controlled the gaining of new knowledge and experiences. A person's value-related attitudes towards objects and situations and the organization of values and beliefs about self can be thought of as forming a comprehensive belief system that provided an individual with a cognitive framework, map, or theory (Ball-Rokeach et al. 1984). In this respect, the models explaining the influence of experiences on teachers' beliefs and practices are largely supported by the findings of this study, which established that early and teacher-education formative experiences were initially interpreted through religious beliefs.

In addition, the analysis of the interviews showed that teachers' personal Islamic-religious beliefs embraced their beliefs about what science is and what science should be for. Personal religious beliefs acted as a filter for new experiences; that is, teachers' understanding or interpretations of Islamic religious beliefs worked as the criteria or bases for interpretations of the new experiences. In this case, teachers' understanding of religion determined their understanding of what early experiences meant to an individual at the time of an event. The findings indicated that other family, daily life, and school experiences were viewed through the lens of teachers' personal religious beliefs. Through such beliefs, each teacher had some values that s/he used to evaluate knowledge that had to be accepted and actions that had to be taken.

Personal religious beliefs influence other kinds of teachers' experiences' as well as shaping teachers' beliefs and practices (Fig. 1). The developed PRB model shows that

personal experiences can affect teachers' personal beliefs. However, the interactive influence between teachers' experiences and their personal religious beliefs is not equal. Personal religious beliefs constitute the stronger influence.

Teachers' experiences and pedagogical beliefs

From a cultural perspective, the teachers' pedagogical beliefs are not just simply formed or socialized by their lifetime experiences. They are, in fact, active participants in interpreting these experiences. The particular interpretation assigned to an experience was transformed to a schema, which I take to be "a way of understanding or a cognitive filter and a basis for teacher-centered classroom practices" (Knowles 1992, p. 138). The term instructional schema meant a settled system of pedagogical beliefs following the process of filtering by teachers' previous religious beliefs and experiences. In this teachers' prior experiences had molded their educational thinking and through the interpretations of these experiences, they formed the beliefs that they used directly to evaluate their own teaching practices.

The interpretation and subsequent schema developed by an individual with regard to classroom practices and other relevant experiences was highly idiosyncratic. Individuals experiencing a singular event would have multiple perspectives on that event. The schema or settled beliefs determine the manner in which teacher might take certain steps, so that the schema becomes an evaluative tool for examining teacher practices and are transformed into a framework for action. For example, teachers who view science as a body of knowledge rely on textbooks to assist them in transmitting science knowledge. A teacher who believes that science is merely a body of knowledge to be acquired will have a very different approach to teaching science from one who believes science is a way of making sense of the world, of asking questions and seeking answers, observing, and exploring (see Fig. 1). The figure shows that teachers' beliefs were among the major constructs driving teachers' ways of thinking and classroom practices. So far, the developed PRB Model (Fig. 1) has highlighted the idea that teachers' interpretation is the link or the transmitter between teachers' experiences and their beliefs.

Teachers' cultural views of the science curriculum

Some interviewees felt that the current science curriculum reflected a "monoculture," that is, a western culture rather than their Arab culture. They remarked that the curriculum was focused on the development of western science and that this might negatively affect the students' identities and their attitudes towards learning science or taking up careers in science. In this respect, "when science is put in an historical context in school, that context is often biased, with the work of white scientists being overrepresented" (Reiss 1993, p. 70). Therefore there is a need for curriculum developers to think about "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. Furthermore, science education should be universal and encourage students to wonder about the natural world and to shape their own scientific thinking. These aims can be achieved by the full adoption of a multicultural and anti-racist perspective on science.

In science education, we can often find a universalists' argument for an all-inclusive view of science (Stanley and Brickhouse 2001). Accordingly, western modern science (WMS) provides a superior knowledge of the natural world, compared with pre-modern European thought or the various "folk thought," "ethno-sciences," and other less creditable forms of knowledge held by non-Western cultures. In light of the findings that some

science teachers have negative attitudes toward western science, teacher educators should not simply focus their efforts on the question of what kind of science (WMS or local “ethnic” science) to teach to indigenous or religious people whose worldviews are distinctly different from mainstream western ones. Rather we 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.

Conclusion and implication: Sociocultural contexts and PRB as a formwork of teaching science and religion issues

Here at the end of this paper I endeavor to point out that the concept of science in a religion will depend on the interpretations of the religious principles as understood by its followers during a certain period and may differ across time. Religion influences science only to the extent that its interpreters could persuade other people to adapt their conceptions. In fact it would be misleading for our purpose of teaching/learning science to consider the religious conceptions alone without taking into account the other sociocultural contexts in the situation that may collectively influence science.

By dealing and interacting with the sociocultural contexts, teachers create their own zone of understanding and interpretation of Islam related to science. This zone, as shown in Fig. 2, the personal religious beliefs or “PRB zone.” Teachers sometimes created a false contradiction between Islam and science due to their individual interpretations of the nature of Islam and science. That is why, as shown in the top left of Fig. 2, there is a big gap between teachers’ understanding, interpretations, epistemology, and ontology of the socioscientific issue related to religion, on the one hand, and the religion’s epistemology and religion of the same issue, on the other hand. This gap might be created due to the lack of the awareness by the right understanding of religious beliefs (RB zone) of science or a controversial issue.

Most of the teachers’ religious experiences related to teaching controversial issues were from informal sources (including family, previous teachers, and the media). Educational decision makers and science educators around the world should be made aware that teachers’ personal religious beliefs within sociocultural context are a highly effective variable that can have a positive or negative influence on the entire educational process. Teachers’ personal religious beliefs could be considered a positive factor in developing positive attitudes among teachers towards science and science teaching. It is therefore suggested that decision makers, curriculum developers, and science educators engage in thoughtful reflection and discussion about developing various study programs. These would act as formal knowledge sources about the relationship between science and religion and would also train teachers how to debate issues related to science and religion.

To minimize the gap between the RB zone and the PRB zone, a formal experience about the relationship between science and religion should be based on the coordination among the scientific institutions and the religious one. I agree with the position that compatibility is needed between religious education and science education. In cultures where religion has a major influence on people’s lives the development of science curricula should be made in a partnership between science educators and religion scholars, especially with regard to socioscientific issues associated with religion. This process would provide opportunities to challenge teachers’ personal religious beliefs, to introduce appropriate perceptions of religious attitudes, and to leave the door open for different views and different understandings. By this educational process, the PRB zone will get to the stage to match the RB

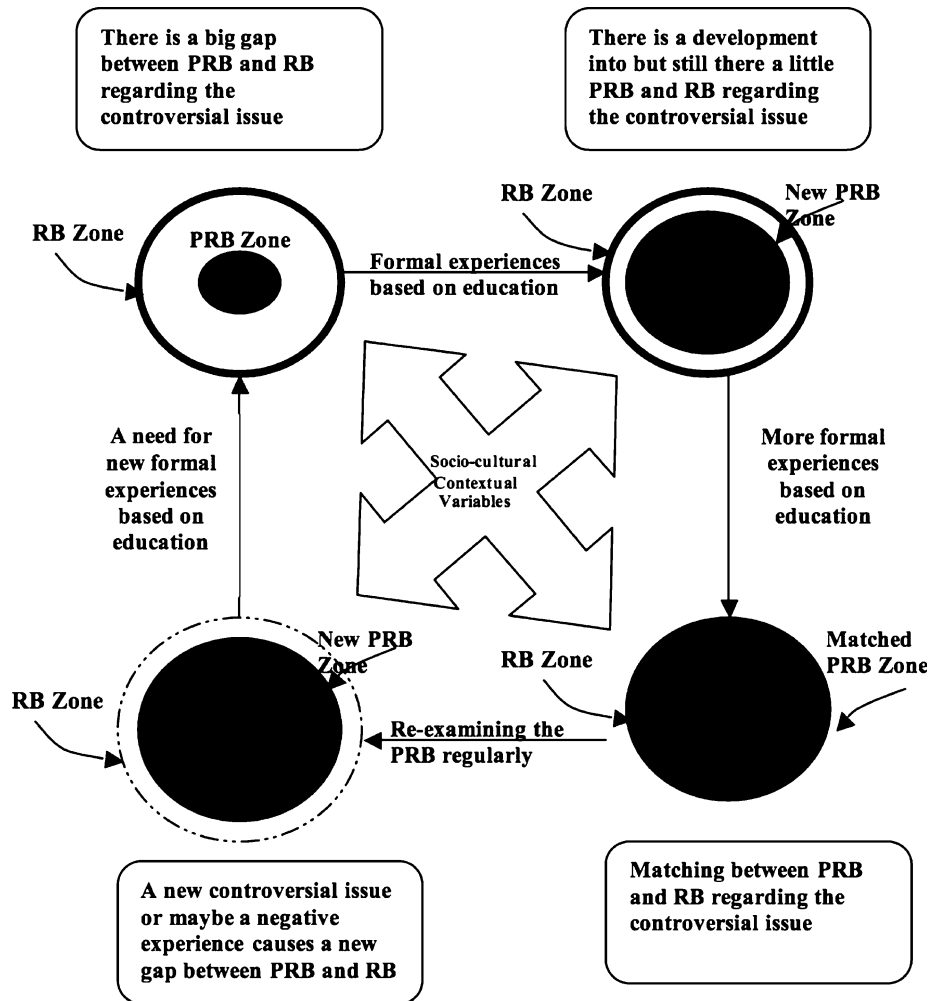


Fig. 2 Sociocultural contexts and PRB

zone. However, the development of advanced technology and scientific research, new controversial issues are likely to emerge that will cause new gaps between PRB and RB. This will require a regular examination of the PRB and teacher training. Also, in cultures where religion has a major influence on peoples' lives the development of science curricula should be made in a partnership between science educators and religion scholars, especially with regard to socio-scientific issues associated with religion.

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