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# **MADRASAH SCIENCE TEACHERS' PERSPECTIVES ON THE NATURE OF SCIENCE, TEACHING AND LEARNING OF SCIENCE**

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## **Abstract**

In Singapore, science teachers in Madrasahs work in an environment where Islamic principles are pronounced. The curriculum offers both Islamic and secular studies. One aspect of its secular studies is science. The content of the science syllabus is primarily based on modern science. This research aims to document the current views of science educators in the Madrasahs about the nature of science, teaching and learning of science, and the nexus between Islamic culture and modern science. A total of 35 Madrasah science teachers, representing about 97% of the Madrasah science teachers in Singapore, responded to a survey instrument for the purpose of this research. Results showed that science teachers in Madrasahs had positive attitudes about science. Almost all teachers feel that science and Islam could be integrated, and that science should be taught in the classroom. The teachers were also comfortable in treating science as a domain which can be harmonised into their own culture.

## **Introduction**

Research on teacher's beliefs about science has received much attention in recent years from educators, as the educational paradigm has shifted from behaviourism to constructivism. Many educational researchers agree that teachers' beliefs may, in some way, affect teachers' instructional practise and eventually their students' ways of thinking. The knowledge, beliefs, and theories that a teacher holds about the nature of science as well as the teaching and learning of science determine to a great extent what science education will be for a given child (Ambimbola, 1983). Songer and Linn (1991) have shown that students' views about the nature of science do influence the outcomes of their learning in science – and this is, to a certain extent, shaped by the teachers' attitudes about science.

Hodson (1998) has suggested that there are two major reasons for the failure of modern education to achieve the objective of improving students' understanding of the nature of science – one is the teachers' own inadequate views about the nature of science, and another is the degree of confusion in the philosophical stance inherent in many of these curricula. In the Singapore context, Boo (1995) has investigated the views of pre-service and in-service teachers about the nature of science, the aims of science education and science instruction. She found that

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the majority of pre-service and in-service teachers in her study had a rather limited or superficial view of the nature of science.

The need for teachers to have positive attitudes in science is a given in today's society. Young (1998) has suggested that if changes are to be made in the uptake of science by pupils at all levels, then positive attitudes must be formed during the students' primary and secondary school days. This, in turn, relies on teachers themselves having a positive attitude towards this area of the curriculum. Young also found that it was crucial that positive attitudes towards science be developed and maintained in order that learning can take place.

Further research by Coborn and Loving (2002) and Levitt (2001) have also shown that positive attitudes about science were held by teachers in their respective studies. In particular, Levitt has suggested that teachers' beliefs about their role in elementary science do influence decisions about the teaching of science. In a study of sixteen teachers from two school districts in Pennsylvania, USA, she found that teachers believed that the teaching of science should be student-centred. This belief was contrary to the ones held by teachers in the United Arab Emirates, who thought that science learning centred mainly upon the transmission of verified knowledge (Haidar, 2002), and by Taiwanese teachers (Tsai, 2002), who held traditional beliefs in teaching science, that is, science is thought to be best taught by transferring knowledge from teacher to students.

Levitt (2001) further found that teachers believed that students should be active participants in the learning of science, not just passive recipients of information. The teachers also felt that students should be engaged in hands-on activities when learning science, and that the learning of science should be meaningful to students. This was similar to the findings of Haidar (2002) who found that science learning is believed to be centred upon students making personal meaning out of scientific knowledge.

In defining science, various interpretations exist in the beliefs of teachers worldwide. Young (1998) has found that teachers identified science in terms of disciplinary contexts used in the school curricula, for example, biology, physics and chemistry. Science was believed to be intellectually useful but was not seen as useful in everyday life. In addition, science was seen as something to be dealt with by specialists - it was not seen as having a day-to-day impact on an individual's approach to life. Also, teachers perceived science as finding out about the world. This was quite similar to the beliefs of Taiwanese teachers, who thought that science is a representation of truth and the provision of answers (Tsai, 2002). On the contrary, teachers in the United Arab Emirates thought that science is more about inventing or designing things (Haidar, 2002). In a Singapore study on 40 practising science teachers, Boo & Toh (1998) found that teachers subscribed to the view of science as largely a collection of facts.

Culture, as an overarching attribute of an individual's social environment, has attracted the attention of social constructivists in recent years as they sought to establish its nexus with science learning. Aikenhead (1997) has observed that students feel that school science is like a foreign culture to them. This feeling stems from the fundamental differences between the culture of modern science and the culture of indigenous societies. In the Arab culture, the work of Haidar (1997) on science teachers' worldview presuppositions and the nature of science teaching and learning has also shown the influence of culture on the teaching and learning of science. It can therefore be argued that cultural studies in science education do play a major role in the teaching and learning of science in non-Western societies. Interestingly, this also applies to minority and religious groups in the Western world (Coborn 1993, Costa 1995, Aikenhead

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1996). In these studies, the definition of culture was taken as the “norms, values, beliefs, expectations, and conventional actions” of a group (Phelan et al, 1991).

Though the foregoing studies have made significant contributions towards our understanding of the nature of science, there is an absence of studies which examine the attitudes of science teachers in Islamic seminaries as well as of these teachers in multicultural settings. The Singapore setting offers a unique context to undertake this study as science education in the Madrasahs is offered in a religious environment. The majority of schools in Singapore do not have such an environment. Also, no research has so far been undertaken to study the views of Madrasah science teachers on science issues. This study therefore aims to document the current opinions and beliefs of science educators in the Madrasahs about science and culture as well as their connections and possible effects on teaching and learning. As Singapore is a multi-cultural and multi-religious society that places great emphasis on science and technology driven socio-economic development as well as the peaceful co-existence of all religious groups, such an environment further affords a context to see how these settings have shaped the beliefs of Madrasah science teachers’ about science as compared to their counterparts in homogeneous societies elsewhere such as, for example, in the Middle East.

### **Madrasahs In Singapore**

A Madrasah, by definition, is an “institution for the training and formation of ulama” (Algar, 1987); the word ‘ulama’ means the learned and refers to scholars of Islam who are the guardians, transmitters and interpreters of its sciences, doctrines, and the laws and the chief guarantors of continuity in the spiritual and intellectual history of the Islamic community.

The first-full time Madrasah built in Singapore was the Madrasah Alsagoff Al-Arabiah, which was set up in 1912. In 1925, Madrasah Al-Arabiah was built and this was followed by Madrasah Aljunied Al-Islamiah in 1927. These three Madrasahs were built on wakaf lands bequeathed by Muslim philanthropists in the 1900’s. The other three Madrasahs are Madrasah Al-Maarif Al-Islamiah, Madrasah Al-Irsyad Al-Islamiah, and Madrasah Wak Tanjong. They were built in 1936, 1947 and 1958 respectively.

All the six Madrasahs offer both religious and secular education. Each Madrasah has its own curriculum, which is generally holistic. Students learn the Arabic language, Islamic history, and other Islamic subjects. In addition, students learn Mathematics, Science and the English language. Currently, students in the Madrasahs take the Singapore-Cambridge GCE ‘O’ level examinations on top of their Secondary Four Religious Examination, which is administered by Majlis Ugama Islam Singapura (Muis), a statutory board under the Ministry of Community Development and Sports. Under the Compulsory Education Act, starting from the year 2008, it will be mandatory for Madrasah students in Primary 6 to take the Primary School Leaving Examination.

The total enrolment in the Madrasahs is about 4420 students. Each year, about 400 students enrol in Primary 1, the starting point for Madrasah education. Madrasahs are basically funded by donations from the public as well as by grants provided by Muis. The financial dispensation is in the form of student grants, teachers’ top-up allowances, training and development budget for teachers, and so on. Under the Administration of the Muslim Law Act, all Madrasahs are under the jurisdiction of Muis, though each Madrasah has its own management committee to administer its operations.

Madrasah teachers are recruited by individual Madrasahs on the basis of their qualifications and experience. Currently, 25 out of the total 220 Madrasah teachers are undergoing a Diploma in Education programme.

## Methodology

### *Subjects*

35 science teachers from five full time Madrasahs in Singapore responded to a survey for the purpose of this study. They were either teaching science subjects or will be teaching science. A profile of the teachers who participated in this study is indicated below:

#### *Gender*

Male: 23%      Female: 77 %

#### *Academic Qualification*

Degree: 48 %      'A' levels: 17 %      Diploma: 26 %      'O' levels: 9 %

#### *Age Group*

20 – 29 :	40 %
30 – 39 :	49 %
40 & above :	11 %

#### *Language stream in which educated*

English      100 %

	Mean	Std Deviation
Teaching experience in full time Madrasahs	3.8 years	4.1 years
Teaching experience in national schools	1.3 years	2.2 years
Number of hours per week in teaching science	5.4 hours	5.2 hours

One Madrasah did not participate in this study as it did not offer formal science subjects in its curriculum. The authors conducted the survey on three different dates and venues as some teachers could not attend on the initial day of the survey. However, most of the teachers (27) completed the survey on the initial day. Three of the teachers completed the survey on the second day while another five completed it on the third day. Only one teacher was not able to participate.

### *Survey instrument*

The original instrument was due to Aikenhead and Huntley (1998). This instrument was later revised by Jegede & Ogawa (1999) and by Haidar (2002) for their studies. Against the backdrop of the foregoing, the original instrument was reviewed for its suitability in the Singapore context while keeping in mind the revisions done by Haidar (2002). A number of items in the instrument were fine-tuned, changed or deleted to suit the conditions of Islamic culture in Singapore as well as the school culture in the Madrasahs. The revised instrument was validated by three doctorates from the National University of Singapore and the Nanyang Technological University in Singapore as well as by a prominent leader of an Islamic organisation in Singapore. Validation included the following:

- i)      use of language,
- ii)     structure/ layout of the survey, and
- iii)    scope / coverage of questions.

Based on their feedback, a few statements were slightly refined. The instrument was later pilot tested on three Muslim teachers who have taught science in a Madrasah or were teaching science in national schools. The results showed that the instrument was adequate for the purpose of this study.

The final instrument consisted of 50 items distributed into 5 sections:

- i) teachers' opinions about science,
- ii) teachers' opinions about science and culture,
- iii) teachers' opinions about science and everyday common knowledge,
- iv) teachers' opinions about culture and
- v) teachers' opinions about teaching and learning of science.

The instrument was in English, as all Madrasah science teachers have been educated in the English medium and are comfortable with the use of English for communication. It was felt that it was not necessary to translate the statements in the instrument into Malay, a language which all of them are able to read, write and speak.

On the day of administration of the survey instrument, the teachers were briefed about the purpose of the research and assured that the survey was completely anonymous and that they need to provide their frank opinions on the various statements. The teachers were requested to respond to each of the 50 items in the survey instrument according to how they felt about science and other issues, using a Likert scale of 1 to 5. The points corresponding to the Likert responses were as follows:

**1 – Strongly Disagree, 2 – Disagree, 3- Not Sure, 4- Agree, 5 – Strongly Agree.**

The survey instrument took about 30 minutes for completion.

## Results

### *Data analysis*

Descriptive statistics were used for data analysis in this study. Frequency counts and percentage points were calculated for each of the five responses corresponding to each of the 50 items. The means and standard deviation for every item were also calculated.

The Cronbach Alpha parameter was used to test the internal consistency of the 50-item survey instrument. Its value of 0.78 is above the norm of 0.70 recommended by Nunnally (1978), and thus indicates good reliability of the survey instrument.

### *Survey results*

The results of the study about Madrasah teachers' opinions about science and culture as well as their connections and possible effects on teaching and learning are presented hereafter according to the five sections explained earlier.

### *Madrasah teachers' perspectives about science*

The teachers' views about science were assessed by 12 items in Section A: Items 1 (a-f) assessed the definition of science, Items 2 and 3 assessed the relationship between science and technology, Item 4 assessed the role of gender, and Items 5-6 assessed the relationship between

science and nature, and life. The respondents' feedback to this section are summarised in Table 1.

**Table 1 Madrasah science teachers' views about science**

No.	A. Science Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree	Mean	Std. Deviation
1a	Science is best described as a body of verified knowledge, such as principles, laws, and theories, which describe and explain the world around us.	42.9	57.1	0.0	0.0	0.0	4.42	0.50
1b	Science is best described as exploring the unknown and discovering new things about our world and universe and how they work.	60.0	40.0	0.0	0.0	0.0	4.60	0.49
1c	Science is best described as rational perceiving of reality.	28.6	62.9	5.7	2.9	0.0	4.17	0.66
1d	Science is best described as inventing or designing things (for example, artificial hearts, computers, space vehicles).	37.1	57.1	0.0	5.7	0.0	4.26	0.74
1e	Science is best described as finding and using knowledge to make this world a better place to live in (for example, curing diseases, solving pollution problems, and improving agriculture).	45.7	54.3	0.0	0.0	0.0	4.46	0.50
1f	Science is best described as an organization of people (called scientists) who have ideas and techniques for discovering new knowledge.	20.0	45.7	8.6	20.0	5.7	3.54	1.19
2	Science is the basis of most technological advances	45.7	37.1	8.6	8.6	0.0	4.20	0.93
3	Technology does not need to have a scientific basis, in fact technology can advance on its own.	5.7	14.3	20.0	40.0	20.0	2.46	1.14
4	Science generally represents a male perspective of the world.	0.0	14.3	22.9	22.9	40.0	2.11	1.10
5	Every occurrence in nature has a scientific explanation.	11.8	26.5	11.8	44.1	5.9	2.94	1.20
6	Science provides the most plausible explanations of natural phenomena.	14.3	45.7	17.1	20.0	2.9	3.49	1.06
7	Science can teach how to survive in everyday life situations.	22.9	48.6	2.9	22.9	2.9	3.66	1.16

The results showed that Madrasah science teachers unanimously (100 %) thought that science is a verified body of knowledge, that it is about exploring the unknown and discovering new things about the universe, and that its purpose is to make this world a better place to live in. (Items 1a, 1b and 1e). 91.5 % of the teachers also thought that science is about rational perceiving of reality (Item 1c), and 94.2 % thought that science is also about designing or inventing things (Item 1d). Responses to the statement that science is an organisation of scientists (Item 1f) varied – the mean of 3.54 is roughly equivalent to a stand between 'Agree' and 'Not Sure'.

The teachers' responses to Items 1(d), 2, and 3 suggests that they have some misconceptions about the difference between science with technology. They thought that science was about inventing and designing things, and that technology is applied science.

On the role of gender, 62.9 % of the Madrasah teachers disagreed that science represents a male perspective of the world. Of those who disagreed, 72.7% were females.

Whereas 38.3 % believed that every occurrence in nature has a scientific explanation, 49 % thought otherwise. 60 % thought that science provides the most plausible explanation of natural phenomena. Most teachers (71.5 %) also thought that science can teach us how to survive in everyday life situations.

*Madrasah teachers' perspectives on the relationship between science and culture*

The teachers' views about the relationship between science and culture were assessed with 11 items in Section B. Items 1 and 10 assessed the connection between science and Western culture. Items 4 and 5 assessed specifically on the relationship between science and Islam. Items 3 and 6 assessed the connecting relationship between science and traditional culture, and community's beliefs. Items 2, 7, 8, 9 and 11 assessed the teachers' opinions about the power of science. Their responses to this section are summarised in Table 2.

**Table 2 Madrasah science teachers' views about relationship between science and culture**

B. Science and Culture		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree	Mean	Std. Deviation
No.	Item							
1	Science is often seen as a subculture of Western culture.	5.7	14.3	20.0	45.7	14.3	2.51	1.09
2	Scientific knowledge, once acquired, often dominates one's way of thinking.	5.7	28.6	20.0	37.1	8.6	2.86	1.16
3	Science alienates people from their traditional culture.	2.9	17.6	5.9	61.8	11.8	2.38	1.02
4	A person can integrate science with Islam.	74.3	25.7	0.0	0.0	0.0	4.74	0.44
5	If Madrasah students master science, they will likely to lose something valuable of their own Islamic culture.	0.0	0.0	0.0	40.0	60.0	1.40	0.50
6	When science is practised in a community, it reflects a community's values and beliefs.	5.7	37.1	25.7	22.9	8.6	3.09	1.09
7	Science will progress the same way, irrespective of the culture of the scientists involved because science is universal.	23.5	61.8	11.8	2.9	0.0	4.06	0.69
8	Science can help the progress of non-Western people if they would only integrate science into their way of thinking.	14.7	52.9	11.8	17.6	2.9	3.59	1.04
9	Science can empower people who belong to a traditional culture, as long as those people learn science, without taking on the Western beliefs that are a part of science.	11.8	52.9	23.5	11.8	0.0	3.65	0.85
10	Western beliefs, values, and conventions are an implicit aspect of science.	0.0	23.5	32.4	35.3	8.8	2.71	0.94
11	Science teachers attempt to socialize or enculturate (immerse in the particular way of thinking) students into a community of scientific practitioners.	5.9	41.2	32.4	20.6	0.0	3.32	0.89

All teachers (100 %) agreed that a person can integrate science with Islam (Item 4). In addition, all of them (100 %) disagreed that Madrasah students will lose something valuable of their own Islamic culture if they master science (Item 5).

Most teachers concur with the items related to the power of science. 85.3 % agreed that science will progress irrespective of the culture of the scientist (Item 7). 67.6 % agreed that science can help people progress if it could be integrated into their way of thinking (Item 8). And 64.7 % thought that science can empower people (Item 9). The teachers' responses to Item 2,

that science knowledge can dominate one's way of thinking, varied. They were not sure if science teachers attempt to enculturate students into a community of scientific practitioners – the mean score of 3.32 for Item 11 is equivalent to a 'Not Sure' response.

Most teachers disagreed (73.6 %) that science alienated people from their traditional culture (Item 3). This is congruent with Item 4, where all of them agreed that science can integrate with Islam and be part of their culture. However teachers were not sure if practising science reflected the community's values (Item 6) – mean score of 3.09 is equivalent to a 'Not Sure' response.

More than half of the teachers disagreed (60 %) that science is a subculture of Western culture (Item 1). Their responses for Item 10, that Western beliefs are an implicit aspect of science, varied.

*Madrasah teachers' perspectives about the relationship between science and everyday common knowledge*

The teachers' views about the relationship between science and everyday common knowledge were assessed using seven items in Section C. Items 1 and 7 assessed the teachers' opinions about the compatibility of scientific ideas between the Muslim community and personal ideas. Items 2-6 assessed teachers' opinions about the differences between science and common everyday knowledge. Their responses to this section are summarised in Table 3.

**Table 3 Madrasah science teachers' opinions about relationship between science and everyday common knowledge**

C. Science and Everyday Common Knowledge		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree	Mean	Std. Deviation
No.	Item							
1	Scientific ideas are compatible with ideas within the Muslim community.	17.1	60.0	11.4	11.4	0.0	3.83	0.86
2	Scientific knowledge stands out as being separate from the common knowledge of the Muslim community.	0.0	11.4	17.1	54.3	17.1	2.23	0.88
3	Science and everyday occurrences are so different, it is almost like they belong to different worlds.	0.0	2.9	5.7	54.3	37.1	1.74	0.70
4	Madrasah students' beliefs in everyday common knowledge inhibits their science learning.	2.9	31.4	14.3	40.0	11.4	2.74	1.12
5	Evidence arrived at through scientific means is not always regarded as sensible to everyday common knowledge.	2.9	37.1	25.7	28.6	5.7	3.03	1.01
6	Scientific explanations and everyday common knowledge of natural phenomena should always be treated as one.	8.6	48.6	25.7	17.1	0.0	3.49	0.89
7	It is easy to incorporate science into one's personal views of nature.	11.4	68.6	8.6	8.6	2.9	3.77	0.88

The results showed that most teachers believe that scientific ideas are compatible with ideas within the Muslim community and their personal views of nature. 77.1 % believed that science is compatible with the community (Item 1) while 80% agreed that it was easy to incorporate science with personal views of nature (Item 7).

Most teachers disagreed that there was segregation between scientific knowledge and everyday common knowledge. As seen in the result for Item 3, 91.4 % of the teachers disagreed

that science and everyday occurrences are so different. It was noted that although 51.4 % of the teachers disagreed that common everyday knowledge can inhibit Madrasah students in science learning (Item 4), a significant 34.3 % agreed to this statement. The teachers were not sure if scientific means for adducing evidence is not regarded as being sensible with everyday common knowledge – this is reflected in the mean score of 3.03 for Item 5..

#### *Madrasah teachers' perspectives about culture*

The teachers' views about culture were assessed by using eight items in section D. Items 1, 2 and 3 assessed the teachers' opinions about the definition of culture. Items 4-6 assessed teachers' opinions about the formation and transformation of a culture, while Items 7-8 sought teachers' views about learning another culture. Their responses to this section are summarised in Table 4

**Table 4 Madrasah science teachers' opinions about culture**

D. Culture		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree	Mean	Std. Deviation
No.	Item							
1	Culture is the lifestyle of a people.	17.1	68.6	2.9	8.6	2.9	3.89	0.90
2	Culture is a system of meaning that people create for themselves.	28.6	57.1	11.4	2.9	0.0	4.11	0.72
3	Culture is the totality of a people's identity.	20.0	42.9	11.4	22.9	2.9	3.54	1.15
4	The expression of culture is influenced most by peers and family members.	11.8	76.5	5.9	2.9	2.9	3.91	0.75
5	The culture of a people is permanent because it is transmitted from one generation to another.	8.6	28.6	11.4	45.7	5.7	2.89	1.16
6	Cultural knowledge is embodied most of all in one's language.	8.6	45.7	20.0	25.7	0.0	3.37	0.97
7	Learning another culture's way of thinking about natural phenomena, can empower people by providing them with a new way of thinking.	17.1	65.7	11.4	5.7	0.0	3.94	0.75
8	Cultural absorption can oppress people by marginalizing or dominating their ideas.	5.7	31.4	37.1	25.7	0.0	3.17	0.89

Most teachers (85.7 %) define culture as the lifestyle of people (Item 1) and a system of meaning that people create for themselves (Item 2). With regards to formation of culture, most teachers (88.3 %) viewed that culture was influenced by peers and family (Item 4). 82.8 % of the teachers believed that learning another culture's way of thinking about natural phenomena can empower people by providing them with a new way of thinking (Item 7). This is to be considered as a positive sign towards interacting with other cultures.

#### *Madrasah teachers' perspectives about teaching and learning science*

The teachers' views about teaching and learning science were assessed by using 12 items in Section E. Items 1, 2, 3 and 4 assessed the teachers' opinion about the present situation of science teaching and learning in the Madrasahs. Items 5 and 6 sought teachers' opinions about the relationship of science concepts with the Muslim community. Items 7 and 10 assessed teachers' views about science as a foreign culture and its connection with students' learning. Items 8-9 assessed teachers' opinions about teaching science and Islamic knowledge in the classroom, while Items 11-12 sought teachers' views about science teachers' responsibilities. Their responses to this section are summarised in Table 5.

**Table 5** Madrasah science teachers' opinions about teaching and learning science

No.	Item	E. Teaching and Learning Science					Mean	Std. Deviation
		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree		
1	The teaching of science mainly centres upon the transmission of verified knowledge.	8.6	68.6	2.9	20.0	0.0	3.66	0.90
2	The teaching of science mainly centres upon students making personal meaning out of scientific knowledge.	20.6	38.2	14.7	23.5	2.9	3.50	1.16
3	Most of the current science teaching methods encourage mere acquisition of unrelated information.	2.9	17.1	20.0	60.0	0.0	2.63	0.88
4	The science concepts taught in Madrasah have no meaningful use beyond passing examinations.	5.7	5.7	0.0	60.0	28.6	2.00	1.03
5	Science concepts taught in Madrasahs reflect the dominant culture in my immediate community.	0.0	25.7	20.0	48.6	5.7	2.66	0.94
6	Science teaches the rejection of ideas held by Muslim community.	0.0	2.9	8.6	45.7	42.9	1.71	0.75
7	School science imposes a foreign set of cultural values on a Madrasah student.	0.0	5.7	8.6	71.4	14.3	2.06	0.68
8	Science and Islamic knowledge can both be taught in a science classroom.	54.3	42.9	0.0	2.9	0.0	4.49	0.66
9	Science and Islamic knowledge should both be taught in a science classroom.	55.9	35.3	2.9	5.9	0.0	4.41	0.82
10	For many Madrasah students, learning science is like going into a foreign culture.	8.6	5.7	14.3	57.1	14.3	2.37	1.09
11	The primary responsibility of a science teacher is to empower students to think for themselves.	26.5	55.9	5.9	11.8	0.0	3.97	0.90
12	The primary responsibility of a science teacher is to respond to the particular legitimate needs of students, whatever those needs are.	17.6	50.0	26.5	5.9	0.0	3.80	0.81

It can be seen that most teachers (77.2 %) agree that the teaching of science mainly centres upon the transmission of verified knowledge, which is the traditionalist view of the nature of science.

88.6 % of the Madrasah teachers disagreed that science concepts taught have no meaningful use beyond passing examinations (Item 4). 88.6 % of them also disagreed that science taught the rejection of ideas held by the Muslim community (Item 6). Both of these statements showed a positive attitude towards science held amongst the Madrasah science teachers. In addition, almost all teachers agreed (97.2 %) that science and Islamic knowledge *could be* taught in a science classroom in the Madrasahs (Item 8) while 91.2 % thought that science and Islamic knowledge *should be* taught in the classroom in the Madrasahs (Item 9).

With regards to school science imposing a foreign set of cultural values on Madrasah students (Item 7), 85.7 % disagreed. Also, 71.4 % of them disagreed that for many Madrasah students, learning science was like going into a foreign culture (Item 10).

Most teachers agreed (82.4 %) that their responsibility was to empower students to think (Item 11). In addition, 67.6 % thought that their primary responsibility was to respond to the particular legitimate needs of students (Item 12).

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## Discussion

The present study sheds some useful light on the views held by science educators in the Madrasahs in Singapore on a range of issues pertaining to the nature of science as well as the teaching and learning of science.

Madrasah science teachers agree that science is a verified body of knowledge, that it is about exploring the unknown and discovering new things about the universe, and its purpose is to make this world a better place to live in. A significant number of them have some misconceptions about the difference between science and technology as well as the social purpose of science. These particular findings agree with the observations of Haidar (2002) in his study of secondary school science teachers in the United Arab Emirates about their perspectives on the nexus between modern science and Arab culture. According to Ziman (1984), while the social purpose of science is in generating new knowledge for its own sake, the social purpose of technology is in responding to human needs. Science is concerned with understanding the universe, which is agreed by all Madrasah teachers; however the majority of them also believe that science is about inventing and designing things. Mixing up science and technology may have some implications when teaching students about the nature of science, though we feel that that this misconception is not an issue and can be easily addressed.

All the Madrasah science teachers who participated in this study believe that a person can integrate science with Islam. Such a belief contradicts a popular notion that some religions are in conflict with science (Seng, 2001). The latter author also mentions that despite this conflict, there has been a mutually enriching relationship between science and religion over the ages despite a number of unfortunate incidents. Almost all Madrasah teachers believe that science and Islamic knowledge can and should be both taught in a science classroom in the Madrasahs – and this is a significant finding of this study. A curriculum that integrates science and Islam will bring about collateral learning in the classroom, where students construct scientific concepts side by side, and with minimal interference and interaction with their indigenous beliefs (Jegede, 1997). Conflicts of schemata that come about when relating a physical event may arise in the Madrasah classroom when science and Islamic knowledge are integrated and taught in the classroom. What is important is not the existence of conflict of ideas, but the ways in which students and teachers manage the conflicts in their minds. Aikenhead & Jegede (1999) opine that when cultural clashes between the world of modern science and indigenous culture occur, students who do not manage the conflicts successfully may approach the clash in two ways: invent ways to avoid constructing scientific knowledge or, conveniently, store the constructed scientific knowledge in their minds out of harm's way from interfering with their life-world experiences. Such approaches may bring about what researchers call the *Fatima's rule*, whereby students study a subject to pursue what is being tested and do not lead to pursuing deep knowledge.

The teachers disagreed that students in the Madrasahs will lose something valuable of their own Islamic culture if they master science. They disagreed that common everyday knowledge can inhibit students in science learning. Aikenhead and Jegede (1999) have suggested that success in science courses depends on three main factors, i) the degree of cultural difference that students perceive between their life-world and their classroom, ii) how effectively students move between their life-world culture and the culture of science or school science, and iii) the assistance students receive in making those transitions easier. Such a stance prevails where science is considered as a separate culture, however, in this study, science teachers did not perceive students as going into a foreign culture as far as learning science is concerned.

The positive attitudes toward science possessed by Madrasah science teachers is further underscored by their views that science can contribute towards progress as well as empower people. These findings are similar to those found by Coborn & Loving (2002) in their study of teachers in the Midwest, USA, and by Young (1998) in her study of primary science teachers in Sheffield, UK. Attitudes do affect behaviour, and positive attitudes among teachers will lead to good teaching and, subsequently, good learning.

On the relationship between science and culture, Madrasah science teachers disagreed that science alienates people from their traditional culture. They further agree that scientific ideas are compatible within their community. Such a stand suggests that the teachers view science as a domain that can be harmonised into culture. This perception by teachers is very encouraging for a society such as Singapore where science and technology play an important role in socio-economic development. In fact, Jenkins (1999) has suggested that in today's society, it is imperative for citizens to be 'scientifically literate' in order to be able to contribute towards decision-making about issues that have a scientific dimension, whether these issues be personal (e.g. relating to medication or diet) or more broadly political (e.g. relating to nuclear power, ozone depletion or DNA technologies).

When compared to the study on Emirates teachers (Haidar, 2002), this study has demonstrated that science teachers in the Madrasahs in Singapore have more positive views, as gauged by the numerical measures of the various statements in the survey instrument, on the nature of science as well as its implications on the teaching and learning of science (Table 6).

**Table 6 Comparison of selected statements in survey instrument with Haidar's study (2002)**

Item	Total % of responses (Strongly Agree / Agree) for Emirates teachers	Total % of responses (Strongly Agree/Agree) for Madrasah science teachers in Singapore
A person can integrate science with Arab culture / Islam	88.6	100.0
If students master science, they will likely to lose something valuable of their own culture	16.3	0.0
The science concepts taught in the class have no meaningful use beyond passing examinations	41.0	11.4
School science imposes a foreign set of cultural values on a student	11.7	5.7
For many students, learning science is like going into a foreign culture	42.3	14.3

Some of the important reasons for this could be due to the fact that science and technology are deeply embedded in various aspects of societal endeavours in Singapore as well as the fact that science and technology have been key factors that have helped to pivot Singapore up the ranks in the economic league. And this has translated into all round development for the various community groups in Singapore.

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## Conclusion

This study has identified several important findings. Many of the results tend to agree with those of Haidar's (2002) study of science teachers in the Emirates. Firstly, Madrasah teachers had positive attitudes about science. Secondly, almost all Madrasah science teachers saw that science and Islam could be integrated and should be taught in the classroom in the Madrasahs. Thirdly, they were comfortable in treating science as a domain that can be harmonised into their culture. Fourthly, there are some misconceptions among them on the difference between science and technology – this is not considered a significant point as it can be easily addressed.

There is however an important departure from Haidar's (2002) study. Whereas Emirates teachers were not sure if science concepts taught in school science have no meaningful use beyond passing examinations, Madrasah science teachers in Singapore disagreed with this statement.

In summary, this study has shown that science teachers in the Madrasahs in Singapore have positive attitudes towards the nature of science as well as the teaching and learning of science. Moreover, they find that science and religion can be integrated, and that science should be taught in the Madrasah classroom. This is a significant finding in the context of the multicultural setting of Singapore society.

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