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The Impact of Science Teachers' Beliefs on Teaching Science: The Case of Saudi Science Teachers

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Abstract

The researcher aims to investigate Saudi science teachers' beliefs about learning and teaching issues. The sample consisted of 247 middle school teachers in Riyadh, Saudi Arabia. The study conducted in the academic school year 2014/2015, and utilized a questionnaire and an interview that included 10% of the sample. The questionnaire targeted the teachers' conceptions of learning and teaching issues and examined whether these conceptions fit the transmission, or discovery, of constructivist approaches. The interview focused on "authentic scientific resources", the limitations of the word "science", and the possible conflict between science and Islamic resources. The goal of this study was to draw conclusions and pedagogical implications to contribute to a better understanding of science teachers' beliefs. The results show a significant shift toward the discovery approach. However, teachers address science as an issue separate from historical and cultural aspects. Based on the findings of this study, the researcher suggests a number of pedagogical implications.

Keywords: authentic scientific resources, teacher's beliefs, teaching, science education

1. Introduction

1.1 Introducing the Problem

In general, teaching is mainly an outcome of a teacher's perceptions and insight. Consequently, our view of teaching revolves around our own understanding of how learning happens. The instructions and practices in school are a translation of one's educational philosophy, including beliefs about the teacher's role and students' responsibilities. Fisher (2007) emphasizes the need for teachers to understand their own teaching philosophies to work on further improvement.

Teachers' knowledge of content is an important issue that has been extensively investigated in research on teacher effectiveness. Strong content knowledge has consistently been identified as an essential element by those who study effective teaching. Clearly, subject matter knowledge positively affects teaching performance; however, it is not sufficient in and of itself (Stronge, 2002, p. 8). Highly accomplished science teachers use their professional knowledge to engage their students in learning science, and they utilize that engagement to result in learning (Spratt & Florian, 2015, p. 90). This is the process that Shulman (1987) calls "transformation", or what Bishop and Denley (2007) call "transforming science knowledge" (p. 13). In some cases, educators think that if they have the same text, then they will have the same learning outcomes, forgetting that "texts contain meaning to be unraveled. For this reason, we need to get into the habit of questioning what we need… oftentimes, the meanings of texts are embedded or hidden. We thus need the drive, determination and patience to decipher them" (Choo & Yeo, 2007, p. 3). "A further distinction between beliefs and knowledge is that while knowledge often changes, beliefs are 'static'. In addition, whereas knowledge can be evaluated or judged, such is not the case with beliefs because there is usually a lack of consensus about how they are to be evaluated" (Mansour, 2009, p. 27).

During Greenwood's (2002) work training teachers, they consistently told her that even though they knew that allowing children to perform hands-on science was beneficial, they nevertheless avoided teaching it or treated it as an add-on to the "core" of the elementary school curriculum. As a result, Greenwood recognized that she, too, had failed to provide these teachers with the theoretical background to inform their practice. In her words, she had launched into the "how to" of science teaching and had ignored the "why". Greenwood (2002) explained

that once she restructured her workshops so that the attending teachers experienced science as learners would, the workshop participants began to consider changing their own instructional strategies. The teachers recognized that when their ideas were challenged and sometimes shown to be false, they became intensely interested in their learning (pp. 1-3). This experience is reminiscent of the guiding principles for revitalizing teacher preparation in science. The fifth guiding principle states, "All elementary-middle-secondary science education pre-service students must have a sound understanding of the nature of learning and how it can be applied to the learning of science" (Glass, Aiuto, & Andersen, 1993, p. 11).

There is a fundamental need to understand teachers' of teaching and learning. Moreover, it is crucial for science teachers to explore their beliefs about what science is. William and Burden (1997) affirm that teachers' beliefs play a vital role in the teaching-learning process, which is why teachers must be aware of their own beliefs, philosophies and theories. "Recent international education trends have witnessed a widespread push for promoting Western-originating 'learner-centered' approaches, often without adequately considering the challenges involved in crossing cultures. Like many developing countries" (Brinkmann, 2015, p. 342).

The findings of Lucy Avraamidou (2014, 2015a) work on science teachers' identity, synthesize the findings of 29 empirical studies, support the argument that teacher identity is a dynamic, multidimensional and comprehensive construct, which provides a powerful lens for studying science teacher learning and development for various reasons. First, it pushes our boundaries by extending our definitions of science teacher learning and development as it proposes new ways of conceptualizing the processes of becoming a science teacher. Second, it emphasizes the role of the context on science teacher learning and development and pays attention to the experiences that teachers have as members of various communities. Third, it allows us to examine the impact of various sub-identities, personal histories, emotions, and social markers, such as ethnicity, race, and class, on science teachers' identity development. Research on science teacher identity has deepened and complicated our understanding of the role of identity in examining teacher learning and development (Avraamidou, 2015b).

Human perceptions are not fixed; they change rapidly based on several factors. "I believe that every scientist, sometimes in his or her life, owes it to the community to put in some time debunking the pseudoscience du jour. This is a discouraging task, something like taking out the garbage; no matter how much you clean up today, there'll always be more tomorrow" (Trefil, 2008, p. 15). Teachers are not exempt from this need.

Teachers' beliefs are interconnected with their practices because their beliefs deeply influence both their behavior and their perception. Research on teachers' beliefs has mostly focused on teachers' inner views using self-reported mechanisms, including questionnaires and interviews, whereas research investigating whether these beliefs are practiced in the classroom is limited.

Research has shown that pedagogical beliefs guide how teachers plan for their classroom activities and practices and shape teachers' cognitions and behaviors while in the classroom (Pajares, 1992; Calderhead, 1995). However, teachers' beliefs are often unconscious, stable and resistant to change (Kagan, 1992; Pajares, 1992; Wilson, Miller, & Yerkes, 1993). Education researchers have also focused on more intensive studies of the nature and the structure of science teachers' beliefs (Luft, 2001; Tsai, 2002; Wong, Chan, & Lai, 2009; Atweh & Abadi, 2012). There is a wide range of studies related to the nature of knowledge that needs to be learned and the outcomes of the learning process (Bråten & Ferguson, 2015; Macugay & Bernardo, 2013; Chai, Deng, Wong, & Qian, 2010; Chan, 2010; Tsai, 2001).

1.2 Saudi Science Teachers' Beliefs

If we ask first, what are beliefs and how are they determined? The term belief is defined by the Oxford English Dictionary (OED, 1994) as the "mental acceptance of a proposition, statement, or fact as true on the ground of authority or evidence; assent of the mind to a statement, or to the truth of a fact beyond observation, on the testimony of another, or to a fact or truth on the evidence of consciousness" (p. 123).

When examining the present state of thought among Muslim people in general (keeping in mind that science teachers in Islamic societies are part of the whole Muslim nation), three basic approaches can be identified. As presented by Al Alwani (1989, p. 3), the first can be described as the traditionalist approach, which generally considers the Muslim nations' rational thought to be self-sufficient and capable of being presented as it is or with very little alternation. This approach is often described as the approach of authenticity. Science teachers who follow this approach call for the development of the basics of science based on only what is found in the holy Quran and Sunnah (the Prophet Muhammad's acts and sayings) and what is found in Muslim scholars' heritage. These teachers go further, calling for the adoption of science textbooks that come exclusively from Islamic societies.

The second trend considers contemporary Western thought and its world-view, its concepts of existence, life and man, to be universal. Without Western views, a modern culture and civilization cannot be built. This perspective maintains that Western thought must be adopted as a whole, and any consequent negative aspects are the price that must be paid if a modern culture and civilization are to be established. This view is often described as modernistic. Science teachers who adopt this approach see science as a universal subject that must be adopted as is from other countries that are urbanized in their education.

The third trend, or the eclectic approach, advocates yet another view. It contends that one must select from traditional thought that which is most sound and from modern contemporary thought that which one considers and has been proven to be correct and then combine the two to form an intellectual structure that will provide a guaranteed basis for achieving what is required. Based on my interactions with science teachers over two decades, the majority of science teachers in Saudi follow this approach.

The nature of science "was considered as subject matter knowledge alongside photosynthesis, Newton's Laws, pH, and plate tectonics" (Lederman & Lederman, 2014, p. 235). Keeping in mind the need for the fourth guiding principle of revitalizing teacher preparation in science published by NSTA ("All elementary-middle-secondary science education pre-service students should learn scientific content and thinking processes in the context of contemporary, relevant, personal and social issues and problems"; Glass, Aiuto, & Andersen, 1993, p. 11), we find that science teachers in Saudi are used to struggling to combine new discoveries in science, which are usually presented in Western science textbooks or in daily scientific news, and their beliefs. We acknowledge that what teachers believe might be their own understanding of a verse from the Holy Quran or a saying by the Prophet Muhammad and may not necessarily be the correct explanation (Alabdulkareem, 2009).

1.3 What Does the Word "Science" Means in Arabic?

Scientific knowledge is defined according to the following maxim: "Every piece of knowledge is subject to tangible experiment". This definition has been prevalent for centuries and has been adopted by the United Nations Educational, Scientific and Cultural Organization. It has been used as the means of deciding which knowledge is scientific and which is not (Alabdulkareem, 2009).

Through the adaptation of this concept and the widespread reliance on it, revelation was rejected as a source of knowledge, culture and civilization, and all branches of knowledge that are based on revelation were excluded from the field of scientific knowledge, regardless of whether they addressed the tangible world or that which is beyond perception. All of these fields were considered "fables" or "unscientific" knowledge of no benefit whatsoever (Al Alwani, 1989, pp. 9-10).

As a result, the empirical method was considered the only means of gaining scientific knowledge. Man was regarded only as a mass of biological substances. The social sciences and the humanities were subjected to the laws of the natural sciences. Experiments were conducted on animals in an attempt to define laws that could be applied to man in the areas of behavior, response, reaction, influence, obedience, rejection and ways of meeting material and other needs.

Muslims also accepted this approach. As a result, the contemporary social sciences and humanities, using these methods and philosophies, became the basic source for Muslims' education, the formation of mentality and the definition of attitudes toward the values of truth and goodness. The teaching methods and curricula in universities and schools were subjected to this approach.

In contrast, "In America, science education had a somewhat different history. As was fitting for a new country still in the throes of development, Americans from Jefferson and Franklin on saw science as a tool for producing practical results, as a way of getting to what I called … 'business end' of the research pipeline" (Trefil, 2008, p. 116). In the early part of the twentieth century, John Dewey formulated a rationale for general science education that still resonates in the educational establishment today. Arguing for the inclusion of science in the high school curriculum, he noted that one goal of education should be to produce what he called a "scientific habit of mind" (Trefil, 2008, p. 118). Teachers must familiarize themselves with new areas of knowledge. However, it is not the teacher's task to furnish answers to all of the students' queries; rather, the teacher's purpose is to enable students to conduct independent research and to form their own opinions and judgments (Wong, 2008, p. 239).

1.4 Saudi School System

Educational system in Saudi imitates national curriculum and national textbooks. It is a central system taking a hierarchy structure, with high authorities in the Ministry and lower authorities in schools. General education in Saudi Arabia, both for boys and girls, is divided into three levels: elementary (K 1-6), intermediate (K 7-9), and secondary "high" (K 10-12). These levels consist of six years of primary school and three years each of

intermediate and secondary school. The Ministry of Education sets overall standards for the country's educational system. The school year at all three levels consists of two semesters, which are fifteen weeks long. Classes per week vary from 28 to 36 hours per week; the length of each class is 45 minutes. Passing the exam at the end of the school year is essential for moving either from grade-to-grade or from level-to-level. However, students who fail need to take another test in the subject that was failed. If the student fails again, he needs to repeat the grade. In elementary stage there is continuous evaluation instead of exams, where students get a report showing their progress three times during each semester (Alabdulkareem, 2009).

The intermediate student is between 12 and 15 years old. Students in the intermediate level study, besides Islamic studies and Arabic language courses, more general education courses, including: social studies, English language, science, mathematics, computer sciences, art education, and physical education, in 12 subjects, with a total of 35 week/hours. The percentage of science classes in each year is 11.4%.

1.5 Science Teaching Approaches

The three dominant approaches in teaching science are the transmission, discovery, and constructivist approaches. The views of the three approaches on issues related to the meaning of learning and teaching are presented in Table 1 as highlighted by Antoniadou and Skoumios (2013). Teachers' conceptions and beliefs about learning, teaching, the purpose of teaching, and their strategies for addressing students' errors deeply impact their teaching practices.

Table 1. Views of the three dominant teaching approaches (transmission, discovery, and constructivist) on issues related to the meaning of learning and teaching*

Issues	Transmission approach	Discovery approach	Constructivist approach
Learning	Memorization and recall of knowledge	Discovery of new knowledge	Change or modify the original conceptions
Teaching	Process of transforming knowledge to students	Knowledge discovery process by students	Process of constructing knowledge by students according to their initial knowledge
Purpose of teaching	The student must be able to reproduce what was taught	The student must be able to explain what was discovered	The student must be able to give explanations based on his initial conceptions
Main teaching practice	The teacher or the student affirms scientific principles by performing experiments proposed by the teacher	Students discover scientific principles following elements of the scientific method	Students construct new knowledge about the phenomena through an interactive process of initial conceptions that have been created for them and the educational environment
Teacher's strategies to address students' errors	Errors are considered a lack of knowledge and must be avoided	Errors are useful as they show lack of knowledge	The error is a "witness" of the thought process of the individual

* Antoniadou and Skoumios (2013)

1.6 Research Questions and Their Correspondence to Research Design

This research aims to explore the impact of teachers' beliefs on teaching science; and the interconnections between teachers' beliefs and their instructional practices in science classes in addition to the factors that underpin these beliefs. In particular, this investigation seeks to answer the following questions:

- What type of beliefs do science teachers have about learning, teaching and scientific authentic resources?
- What is the correlation between science teachers' beliefs and their instructional practices in science class?
- What are the underpinning factors that constrain these teachers while transforming their beliefs into practice?

2. Methodology of Research

This study has a philosophical nature. Due to the variation in philosophical research approaches, one specific method should be chosen based on the goals of the study (Creswell, 2002; Wolcott, 2001). To investigate teachers' beliefs, a descriptive research method was used to describe teachers' beliefs about learning, teaching, and authentic scientific resources, a questionnaire was developed to elicit teachers' beliefs, and a semi-structured interview was conducted to clarify the participants' answers. The research was conducted during the second semester of the school year 2014/2015 in Riyadh, Saudi Arabia.

2.1 Instruments

This research utilizes the following instruments for data collection:

2.1.1 Questionnaire

To identify the teachers' beliefs related to science teaching and learning, a multiple choice questionnaire was created. Some conceptions of the questionnaire were adopted from the Antoniadou and Skoumios (2013) study. The conceptions were based on the three dominant teaching approaches (transmission, discovery, and constructivist). For each question, teachers were asked to chose only one choice from three answers for each statement; the three choices represents the transmission, discovery, and constructivist approaches in sequence. Teachers were asked to add a brief comment or explanation for each response if needed. The time needed for teachers to respond to the questionnaire was about ten minutes. The questionnaire five questions are addressing the position for each of the following: the meaning of learning, the meaning of teaching, the purpose of teaching, main teaching practice, and teachers' strategies to address students' errors.

The research data were the responses of teachers in the questionnaire and the interviews. The responses of teachers on the questionnaire questions were analyzed according to the data in Table 1. The frequencies and the percentage frequencies of teachers' answers per question were determined.

2.1.2 Structured Open-Ended Interview

The interview was conducted with 25 teachers, who represent 10% of the total research sample, using random selection as described in "The setting and the participants" below. The questions in the interview were about the teachers' beliefs of authentic scientific resources. The interview three questions are: a) What is your definition of an "authentic scientific resource"? b) Some scholars argue that the word "science" in Arabic means a specific type of knowledge; therefore, this word should be for the Holy Quran and authentic Sunnah (Prophet Mohammed's sayings and acts), whereas other branches of knowledge should be stated as two words, such as Natural Sciences or Geographic Sciences. Do you agree or disagree with this, and why?, and, c) If there is a conflict between a known scientific fact or principle and a statement in the Holy Quran or Sunnah, how do you address this?

The interviewee were asked to use their "own words and expressions" to explain their answers for each question, mainly, if they have ideas different than what is stated in other resources "e.g., books, other references like: scholars lectures, science education literatures, etc.", the translation of the interview questions and interview guidelines are presented in (Appendix B).

2.2 The Setting and the Participants

The survey involved 247 middle school male science teachers from public schools in Riyadh, Saudi Arabia. The sample was stratified by conducting sampling to ensure that it would be as representative as possible in terms of geographical regions in the city of Riyadh and the number of years of teachers' service.

The participants characteristics are include: a) majoring in science "fields of physics, or chemistry, or biology", b) a minimum of bachelor degree in science education, c) a minimum of 3 years of experience of teaching "including the current year", d) teaching science this year, e) not currently working as a supervisor or in an administrational works "e.g., principal, deputy principal, etc.".

Due to the separation of schools by gender in Saudi and the necessity of the interview, and a male researcher cannot enter female schools, the study focused only on male teachers, and that meant only male teachers' thoughts could be considered in the findings of this research.

2.3 Data Collection, Instruments and Analysis

The research was conducted in two stages, each of which had three steps. In the first stage, a questionnaire was developed to identify Saudi teachers' beliefs about learning science, teaching science and scientific authentic resources. Next, the questionnaire was given to middle school science teachers. Then, the teachers' responses were analyzed. In the second stage, a structured open-ended interview was conducted with 25 teachers, who represented 10% of the total research sample, and the teachers' responses were analyzed based on the targeted concepts.

The 10% was selected based on random selection from the sample, by choosing the first name from each group of ten teachers, if the teacher did not accept the interview, then the researcher asked the next name in the same group, and so on.

The time teachers needed to respond to the questionnaire was approximately 10 minutes. The interviews lasted for 15 minutes, including the arrangement of the interview. All interviews conducted individually at schools or in the researcher's office, based on the appropriate time and place for each teacher.

The research data were the teachers' responses to the questionnaire and the interviews. The teachers' responses to the questionnaire questions were analyzed according to the data in Table 1 using a quantitative approach for teachers' responses and a qualitative approach for their explanations and comments. The frequencies and the percentages of answers for each questionnaire question were determined Teachers' responses are presented in Tables 2 to 6. For the teachers' responses to the interview questions, a qualitative approach was applied, and for the interview third question, additionally, frequencies and percentage of teachers' beliefs about the conflict between scientific facts and Islamic resources are presented in Table 7.

The Arabic versions of the questionnaire and the interview questions were initially discussed individually with five teachers for feedback and then reviewed by five researchers in the field of science education. According to the comments, corrections were made. The final questionnaire included five questions (Appendix A), and the interview included three questions (Appendix B).

3. Results of Research

3.1 The Questionnaire Results

3.1.1 The Meaning of Learning

Table 2 presents the results of the teachers' responses concerning their beliefs about the meaning of learning. The results show that the majority of teachers perceived learning as the discovery of new knowledge (67.21%), which represents the discovery approach. The notion that learning is a modification of students' previous knowledge, showing the constructivist approach, was expressed by a smaller number (27.12%), and still fewer considered learning the memorization and recall of knowledge, a transmission approach (5.67%).

In explaining their beliefs, the majority of teachers (87 of 134) stated that they saw the modification of initial knowledge as a way of discovering new knowledge at the same time. Those who saw learning as knowledge memorization and recall stated that there are main concepts and facts that students must memorize and remember to solve problems in science. These teachers shared the same view as the teachers who perceived learning as the discovery of new knowledge or the modification of previous knowledge, who expressed deep beliefs in the importance of memorization and the recall of previous knowledge in new situations.

Table 2. Frequencies and percentage frequencies of teachers' beliefs about the meaning of learning

	N = 247	
Conceptions	Frequency	%
Learning is knowledge memorization and recall	14	5.67
Learning is discovering new knowledge	166	67.21
Learning is modification of initial knowledge	67	27.12

3.1.2 The Meaning of Teaching

Table 3 presents the results for the teachers' responses concerning their beliefs about the meaning of teaching. The table shows that a limited number of teachers saw teaching as the transfer of knowledge (3.65%). The notion that teaching is the discovery of knowledge was expressed more than the other conception (50.20%), though only slightly more than the notion that teaching involves constructing new knowledge based on initial knowledge (46.15%). The results show that the majority of teachers have a discovery approach, an intermediate proportion of teachers hold a constructivist approach, and the minority of teachers holds a transmission approach.

Teachers' comments on this question show that even though they see teaching as the discovery of knowledge or construction of new knowledge based on initial knowledge, they do not practice it in their classes due to the length of the science textbooks that must be completed before the end of the school year. All of the teachers who commented on this question (94) expressed this view.

Table 3. Frequencies and percentage frequencies of teachers' beliefs about meaning of teaching

	N= 247	
Conceptions	Frequency	%
Teaching is the transfer of knowledge	9	3.65
Teaching is the discovery of knowledge	124	50.20
Teaching is the construction of new knowledge based on initial knowledge	114	46.15

3.1.3 The Purpose of Teaching

Table 4 presents the results for the teachers' responses concerning their beliefs about the purpose of teaching. The table shows that 53.85% of teachers see the purpose of teaching as encouraging the student to explain what he discovers, and 28.74% of teachers see the purpose of teaching as having the student give an explanation based on his initial knowledge. Finally, 17.41% of teachers consider the purpose of teaching to involve having the student reproduce what was taught.

The results show that more than 50% of the teachers hold a discovery approach, whereas approximately 30% of the teachers hold a constructivist approach. The minority of teachers, fewer than 20% of those surveyed, hold a transmission approach.

Table 4. Frequencies and percentage frequencies of teachers' beliefs about the purpose of teaching

	N= 247	
Conceptions	Frequency	%
The purpose of teaching is for the student to explain what he has discovered	133	53.85
The purpose of teaching is for the student to give an explanation based on his initial knowledge	71	28.74
The purpose of teaching is for the student to reproduce what was taught	43	17.41

3.1.4 Main Teaching Practice

Table 5 presents the results for the teachers' responses concerning their beliefs about the main teaching practices. Most teachers consider their dominant teaching practice to be one in which students discover scientific principles by following the scientific method (51.41%), which reflects a discovery approach. Next, 41.30% of teachers see their main teaching practice as one in which students construct new knowledge about scientific phenomena through an interactive process between their initial conceptions and the educational environment, which is the constructivist approach. Finally, only 7.29% of teachers advocated the transmission approach, in which the teacher or the student affirms scientific principles by performing experiments proposed by the teacher.

Table 5. Frequencies and percentage frequencies of teachers' beliefs about the main teaching practice

	N= 247	
Conceptions	Frequency	%
Students construct new knowledge about scientific phenomena through an interactive process between their initial conceptions and the educational environment	102	41.30
The teacher or the student affirms scientific principles by performing experiments proposed by the teacher	18	7.29
Students discover scientific principles following elements of the scientific method	127	51.41

3.1.5 Teachers' Strategies to Address Students' Errors

Table 6 presents the results of the responses concerning teachers' beliefs about strategies for addressing students' errors. The table shows that the majority of teachers (58.30%) follow a discovery approach, in which they see students' errors as useful because they show where there is a lack of knowledge. We found that 28.74% of the sampled teachers follow the constructivist approach, in which they see students' errors as allowing them to "witness" the individual's thought process. Finally, 12.96% of teachers demonstrate the transmission approach, in which they see students' errors as a lack of knowledge that must be avoided.

Table 6. Frequencies and percentage of teachers' beliefs about strategies for addressing students' errors

	N= 247	
Conceptions	Frequency	%
Students' errors are considered a lack of knowledge and must be avoided	32	12.96
Students' errors are useful because they show a lack of knowledge	144	58.30
Students' errors allow teachers to "witness" the thought process of the individual	71	28.74

3.2 The Interview Results

The researcher interviewed each of the teachers individually to examine their beliefs regarding three questions. The teachers responded to each question before knowing the next question. Participants were asked to use their own words to express their beliefs about each question.

The three questions were as follows:

a) What is your definition of an "authentic scientific resource"?

b) Some scholars argue that the word "science" in Arabic means a specific type of knowledge; therefore, this word should be for the Holy Quran and authentic Sunnah (Prophet Mohammed's sayings and acts), whereas other branches of knowledge should be stated as two words, such as Natural Sciences or Geographic Sciences. Do you agree or disagree with this, and why?

c) If there is a conflict between a known scientific fact or principle and a statement in the Holy Quran or Sunnah, how do you address this?

The teachers' responses were analyzed using content analysis and employing emergent coding techniques. Schadewitz and Jachna (2007) suggested that researchers should begin with inductive coding.

The data thus obtained were categorized in broad categories that explained and expressed the teachers' beliefs by compiling similar views, as follow: the authentic scientific resource, the limitation and limits of the word "science", and the conflict between scientific facts and Islamic resources.

Interviews results based on the three categories were as follows:

3.2.1 The Authentic Scientific Resource

All except one of the 25 teachers interviewed had similar ideas about the definition of an "authentic scientific resource". However, it is clear from their answers that there was misapprehension about what a "resource" is and what "science" is. The majority (22) agreed that an authentic scientific resource is "a piece of knowledge, proven by an experiment" or "something that can be repeated following the same steps, in the same conditions, and having the same results". Only two teachers stated that an authentic scientific resource is a "trusted specialist, like scientific and academic resources". After clarifying with the 22 teachers who misunderstood the definition of a "resource" to be the same as the definition of "science", all except one agreed that they made a mistake or gave a short answer explaining that "this authentic knowledge came from an authentic resource, which is the experiment".

Only one teacher added "authentic Islamic knowledge like the Quran and authentic Sunnah" and the "Prophet Mohammed's sayings and acts" to the description of "scientific and academic resources".

I believe that more exploration need to be added in Arabic science education research to clarify this issue. The idea is, based on Islamic thoughts, Muslims should accept what is stated in the Quran and Sunnah as authentic "including scientific facts mentioned in the two resources", but the problem comes when the person try to explain the context of the Quran and Sunnah based on his own understanding. Also, there are a problem of considering the Quran and Sunnah as scientific resources, or if they should not be seen like this, that is mean, rather they should be as something away from science. This is a long historical dialogue in Islamic world. For sure, it is not easy for readers outside this circle to full understand the issue, mainly readers concerning science education issues in an international aspects. In fact, from the research findings, the conflict and misalignments between scientific resources, and Islamic resources mentioning scientific facts are a problem for most of our teachers.

3.2.2 The Limitation and Limits of the Word "Science"

In response to the second question, which read, Some scholars argue that the word "science" in Arabic means a specific kind of knowledge; therefore, this word should be for the Holy Quran and authentic Sunnah, whereas other branches of knowledge should be stated as two words, such as Natural Sciences or Geographic Sciences. Do you agree or disagree with this, and why?, seven teachers asked to comment on their previous answer to the first question. They added to the authentic scientific resources "the authentic Islamic knowledge related to science and nature stated in the Quran and Sunnah".

Although all teachers said that it was difficult to adopt this idea now because all of the science books are based on Western sciences, they hesitated to determine whether the statement was true. Eleven teachers said that the opposite was true; they saw the single word "science" as equal to "natural sciences", whereas the rest of knowledge branches should add the name of the branch (e.g., Islamic, Geography). Eight teachers stated that they agreed with the statement, but they noted that they could no longer use it because the meaning of the word "science" has changed in Arabic. Four teachers stated that although it is difficult to adopt this idea now, we should change the situation because we have a different definition of the word "science" in Arabic, which we had before learning the meaning of the translated word in English.

Of the 25 teachers, two stated that they did not have an opinion because they had never thought about it.

After hearing the teachers' answers, the researcher added a question during the interview: "Do you think that having two different meanings for the same word could have an impact on teaching science in Arabic?"

The teachers' responses to this question were slow and hesitant. Only three teachers said that they "don't think it has any impact because we use modified American science textbooks for all school levels", and "our students' competitive achievements in scientific fairs and contexts are proof of that". The rest of the teachers did not give a clear position, although 14 teachers agreed that this "could affect teaching science in Arabic if the student has a struggle with the meaning of the word, for example, if other subjects 'other than science' talk about it". The rest of the teachers said it was a good idea to think about, but they did not have an answer.

3.2.3 The Conflict between Scientific Facts and Islamic Resources

In response to the question, If there is a conflict between a known scientific fact or principle and a statement in the Holy Quran or Sunnah, how do you address it?, all 25 teachers agreed that "it is impossible to have a conflict between 'true' or 'real' science and authentic Islamic resources". When teachers were asked what they meant by "true" or "real" science based on their individual answers, they agreed that "true" or "real" science is the "piece of knowledge that cannot be changed in the future". Twelve teachers stated that the conflict could be a "pseudo" conflict based on one of the three reasons: 1) "a misunderstanding of a statement in the Islamic resource", 2) "an unauthentic Islamic resource, something that was falsely claimed to be from the Prophet Mohammed's sayings", or 3) "limited knowledge, causing us to believe something is true that will not hold up to future scientific abilities and discoveries". The rest of the 25 teachers gave one or two of the three explanations, as stated in Table 7.

Table 7. Frequencies and percentage of teachers' beliefs about the conflict between scientific facts and Islamic resources

	N= 25	
Conceptions	Frequency	%
The possibility of a conflict between scientific facts and Islamic resources	0	0
1) a "pseudo" conflict between scientific facts and Islamic resources due to a misunderstanding of a statement in the Islamic resource	5	20.00
2) a "pseudo" conflict between scientific facts and Islamic resources due to an unauthentic Islamic resource, which falsely claims to be from the Prophet Mohammed's sayings	3	12.00
3) a "pseudo" conflict between scientific facts and Islamic resources due to limited knowledge, causing us to believe something is true that will not hold up to future scientific abilities and discoveries	3	12.00
Statements 1 and 2	1	4.00
Statements 1 and 3	2	8.00
Statements 2 and 3	1	4.00
The three previous statements together	10	40.00

4. Discussion

It is widely admitted by science teachers in general that their teaching practices are deeply influenced by the way they learned science. They maintain that their classroom practices are advanced because education has undergone tremendous changes over the last decades. However, it is evident from their classroom observations that they teach in exactly the way they were taught. Research by Volkinsteine, Namsone and Cakanes (2014) on skills for organizing students' scientific inquiry shows that teachers fail to understand that the inquiry process requires active participation by students in the teaching process and a change in the teacher's role from an information provider to a consultant. Moreover, "Given the complex role that teacher's beliefs play in teacher decision-making, it's clear that research on the efficacy of teacher education programs must explore in greater depth the interplay between the development of science teachers personal epistemologies and the link to their instructional practices" (Dolphin & Tillotson, 2015, p. 22).

Recent studies on learning science have shown that trusting students to create their own cases will help them to learn better. A study by Yurco (2014) affirmed that students not only successfully generated valid cases but also that they were enthusiastic about the process and had greater confidence and enthusiasm than had been observed during the previous years. Strimaitis, Scellinger, Jones, Grooms and Sampson (2014) found that students need to learn how to engage in several scientific practices to be considered proficient in science. Many of these practices are needed to evaluate scientific claims made in the popular media. A case study by Zhao, Wardeska, McGuire and Cook (2014) on learning chemistry concluded that by introducing metacognition in learning through specific classroom interventions that were designed to help students develop metacognitive learning strategies, the students came to understand the difference between superficial memorization and real learning.

The results of this study show that the majority of the teachers' responses concerning the meaning of learning represented the discovery approach (67.21%), whereas the constructivist approach was expressed by a smaller number (27.12%), and, fortunately, the transmission approach was represented the least (5.67%). Teachers' conceptions of the meaning of teaching show that the majority of teachers hold a discovery approach (50.20%), an intermediate number hold a constructivist approach (46.15%), and the minority (3.65%) holds a transmission approach. Similarly, the teachers' responses about the purpose of teaching show that most teachers hold a discovery approach (53.85%), with 28.74% of teachers holding a constructivist approach and the minority, less than 17.41%, holding a transmission approach.

The teachers' responses regarding their main teaching practice revealed that most teachers (51.41%) have a discovery approach, with 41.30% who follow a constructivist approach and only 7.29% who follow a transmission approach.

Teachers' responses about their strategies for addressing students' errors show that the majority of teachers (58.30%) follow a discovery approach, with 28.74% representing a constructivist approach and 12.96% of teachers representing a transmission approach.

It is clear that Saudi science teachers mainly follow a discovery approach in all research-targeted areas. Second to the discovery approach followers are a constructivist approach followers, and the least common are followers of a transmission approach.

These results show a major shift for Saudi teachers from the transmission approach toward the discovery approach, with a great number of teachers who follow a constructivist approach, an unexpected finding based on the classroom practices in Saudi science classes reported by previous studies. At the same time, the results do not reflect the goals put forth by science teachers' preparation programs in education colleges in Saudi or the goals of Ministry of Education, where teachers are prepared and trained based on the constructivist approach.

Reflecting a lack of self-confidence, Saudi science teachers struggle to combine their science major with their cultural background. The results shows that teachers view science as a separate issue and cannot easily connect it with the historical and emerging cultural issues. Moreover, teachers are not used to discussing the relationships between natural sciences and students' beliefs.

To generalize the results of this study in a wider view, Saudi science teachers need to move from their current situation in which believing that "… to be good in science meant to reproduce such information as accurately and completely as possible. The focus of this kind of instruction was on what scientists know" (Donovan & Bransford, 2005, p. 397). We have a similar case as (Carey, 2000) argue that science teachers should know that telling students what scientists have discovered is not sufficient for supporting a change in their existing preconceptions about important scientific phenomena (pp. 13-19). Science teachers should know that "the final part of the teaching and learning performance involves the teacher providing opportunities for students to try out and practice the scientific ideas for themselves, to make those ideas their own" (Mortimer & Scott, 2003, p. 21). On the opposite, we can see everywhere that teachers are asking students (only) to follow the steps of "the scientific method", while it is not sufficient for helping them develop the knowledge, skills, and attitude that will enable them to understand what it means to "do science" and participate in a larger scientific community (Donovan & Bransford, 2005, p. 398).

Saudi science teachers should consider the importance of peers' role in revising their practices, "through collaboration with peers using the same curriculum materials for science, teachers can learn to employ their pedagogical reasoning effectively to make instructional decisions about how to foster explanation construction in their own classroom" (Zanigori, Forbes, & Biggers, 2013, p. 1014). Science teachers need to encourage students to analyze and present their own data based on the concept of experiential learning (Kolb, 1984), which postulates that effective learning is based on transformative experiences (Price & Lee, 2013, p. 778).

5. Conclusions and Implications

In conclusion, the researcher offers some important recommendations for Saudi science teachers for improving their abilities:

- Science teachers should know their teaching beliefs.
- Science teachers should move from telling students what scientists have discovered, towards supporting the sufficient change in their existing preconceptions about important scientific phenomena.
- Science teachers should know that the significant part of the teaching and learning performance is providing opportunities for students to practice the scientific ideas and to make those ideas their own.
- Science teachers should know how to help students to develop the knowledge, skills, and attitude that will enable them to understand what it means to "do science" and participate in a larger scientific community, not only practicing the steps of the fixed "scientific method".
- Science teachers need to know that change in their teaching practices requires them to experience a conceptual change in their beliefs about student learning, this is a worldwide concerns, stated in several studies like: Metz (2009), Beyer and Davis (2008).
- And finally, the researcher agree with (Houseal, Abd-El-Khalick, & Destefano, 2014) that science teachers' preparation programs and training sessions should enable them to "(a) generate answerable questions, (b) think scientifically, (c) analyze phenomena, (d) interpret evidence, and (e) engage in meaningful discourse about the validity of the generated claims" (p. 85).

6. Recommendations for Further Research

As a result of this present research, the researcher suggests that future researchers should take care of comparing the impact of male and female science teachers' teachers beliefs on teaching science, such research, needs additional considerations, including male and female researchers working together.

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Appendix A

Questionnaire

General Instructions:

How should respond to this questionnaire?

You should take this questionnaire only if you are:

a) majoring in science "fields of physics, or chemistry, or biology",

b) have a minimum of bachelor degree in science education,

c) have a minimum of 3 years of experience of teaching "including the current year",

d) teaching science this year, e. not currently working as a supervisor or in an administrational works "e.g., principal, deputy principal, etc.".

Background Information:

Name *"Optional"*: .....

School Name: .... Educational Center: .....

About the questionnaire:

Please complete the following questions to reflect your opinions as accurately as possible and to answer questions to the best of your own opinion.

Your responses are voluntary and confidential. If there is a question you do not wish to answer, simply skip it.

Answering Instructions:

For each statement in issues column, please chose only one choice from the three answers, that you think is the best to describe the statement. "Please: Circle the letter before the best answer".

Feel free to add a brief comment or explanation for each response if needed.

Issues	**Issues' Best Explanation**					
Learning	A	Memorization and recall of knowledge	B	Discovery of new knowledge	C	Change or modify the original conceptions
Comments:						
Teaching	A	Process of transforming knowledge to students	B	Knowledge discovery process by students	C	Process of constructing knowledge by students according to their initial knowledge
Comments:						
Purpose of teaching	A	The student must be able to reproduce what was taught	B	The student must be able to explain what was discovered	C	The student must be able to give explanations based on his initial conceptions
Comments:						
Main teaching practice	A	The teacher or the student affirms scientific principles by performing experiments proposed by the teacher	B	Students discover scientific principles following elements of the scientific method	C	Students construct new knowledge about the phenomena through an interactive process of initial conceptions that have been created for them and the educational environment

Comments:						
Teacher's strategies to address students' errors	A	Errors are considered a lack of knowledge and must be avoided	B	Errors are useful as they show lack of knowledge	C	The error is a "witness" of the thought process of the individual
Comments:						

Thank you. This is the end of the questionnaire.

Appendix B

Interview

General Instructions:

How should respond to this interview?

You should take this interview only if you are:

a) among those teachers who respond to the research questionnaire, thus you are:

b) majoring in science "fields of physics, or chemistry, or biology",

c) have a minimum of bachelor degree in science education,

d) have a minimum of 3 years of experience of teaching "including the current year",

e) teaching science this year, e. not currently working as a supervisor or in an administrational works "e.g., principal, deputy principal, etc.".

Background Information:

Name: .....

School Name: ..... Educational Center: .....

About the Interview:

Please complete the following questions to reflect your opinions as accurately as possible, and to answer questions to the best of your own opinion.

Answering Instructions:

For each question, please use your "own words and expressions" to explain your answers for each question, mainly, if you have ideas different than what is stated in other resources "e.g., books, other references like: scholars lectures, science education literatures. etc.".

Your responses are voluntary and confidential. If there is a question you do not wish to answer, simply skip it.

The Interview Questions

- The researcher interviewed each of the teachers individually to examine their beliefs regarding three questions.
- The teachers responded to each question before knowing the next question.

The three questions were as follows:

a) What is your definition of an "authentic scientific resource"?

b) Some scholars argue that the word "science" in Arabic means a specific type of knowledge; therefore, this word should be for the Holy Quran and authentic Sunnah (Prophet Mohammed's sayings and acts), whereas other branches of knowledge should be stated as two words, such as Natural Sciences or Geographic Sciences. Do you agree or disagree with this, and why?

c) If there is a conflict between a known scientific fact or principle and a statement in the Holy Quran or Sunnah, how do you address this?

Thank you. This is the end of the interview.