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Science teachers' perceptions of the cultural factors influencing students' science learning: comparative analysis of Saudi Arabia, Egypt, and Yemen

Fayadh Hamed Alanazi[1], Mustafa Ali Khalaf [2], Mohammed Saleh Alzamil[3] , Abdo Noman M. Almufti[4]

[1]*Department of Curriculum and Instruction, College of Education, Jouf University, Kingdom of Saudi Arabia, fayad@ju.edu.sa, ORCID ID: 0000-0002-8294-2143*
[2]*College of education, Sultan Qaboos University, Oman, Minia University, Egypt. ORCID ID: 0000-0002-2611-6541*
[3]*College of Education, Jouf University, Kingdom of Saudi Arabi, https://orcid.org/0009-0004-6731-196X*
[4]*Centre for Excellence in Science and Math Education, King Saud University, Kingdom of Saudi Arabia, 0000-0003-2024-7791*

Abstract

This study investigates the perceptions of a sample of Arab science teachers pertaining to the cultural factors affecting pupils learning processes in three Arab countries. A randomly sampled group of 169 science teachers from the three countries comprised the participants, Egypt (N=37), Yemen (N=53), and Saudi Arabia (N=79). A questionnaire consisting of 48 items measuring six cultural factors was used to collect data. Descriptive statistics and one-way ANOVA were used to analyse data. Results indicated that teachers in the three countries have a consensus that science is not exclusively an aspect of Western culture. Saudi Teachers' awareness of the influences of the cultural factors on science education was clearer than that of the Egyptian and the Yemeni teachers. There were significant differences in the nature of science subscale, common everyday scientific knowledge subscale, and classroom science teaching and learning subscale, while there were no significant differences in science, culture and community subscale, science learning subscale, and science and real-life subscale. Scheffe post hoc test indicated that Saudi teachers scored higher than their Yemeni peers in their perceptions of nature of science subscale and common everyday scientific knowledge subscale while Egyptian teachers were more likely than Yemeni teachers to perceive cultural factors affecting classroom science teaching and learning. We concluded that cultural factors could facilitate or debilitate science education in schools. It is vital to increase science teachers' awareness of the role that cultural factors play in facilitating science instruction and learning.

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Introduction

Since Science, as a part of cultural identity (Franklin, 1995) is one of the main sources of change in people's life, cultural factors related to science and science education should be taken into consideration by educators. Those societal and cultural changes affect not only the science content, but the instructional activities adopted by teachers in the classrooms (Gurgel, et al., 2016). Haider (1997 in Haidar, 2002) argued that science education programmes against the backdrop of Arab culture should be culturally sensitive and that investigating cross-cultural factors might have a tremendous effect on teaching science. Yet the majority of science teachers believe that science is isolated from cultural norms (Aikenhead, 1997). Other studies (e.g., Gurgel et al., 2016) have argued that the role of scientists not only to promote a great curiosity in learners but also to empower them with the skills needed for a differentiated dialogue between cultures. Although students may correctly explain how some natural phenomena can occur, it is obvious that cultural background and religious beliefs transmit certain interpretations and conceptions to the classroom context. As a result, school students are inclined to attribute natural phenomena such as eclipse, rainfall, lightning, thunder, earthquake and drought to supernatural powers and taboos with reference to their beliefs in a God or gods (Dorsah and Okyer, 2020, Alanazi et al., 2023). Given that pupils face academic difficulties everyday (Khalaf, 2014), teachers of science are required to deal with these difficulties and misconceptions especially those related to science.

Culture includes different sets of standards, values, beliefs, and expectations. Peregoy and Boyle (1993) defined culture as "the shared beliefs, values, and rule governed patterns of behaviour that define a group and require group membership" (p.8). They proposed that culture is comprised of three influential aspects: "*what people know and believe, what people do, and what people make and use"* (p. 8). Teaching science within a cultural perspective has gained great attention nowadays. Shaw (2006) believes that the curriculum content must connect to the social culture of the students, including Islamic culture, and that it must illustrate how to make use of science in developing their country and in solving the problems of everyday life.

Teachers of science who deal with foreign students ought to get familiar with the cultural factors influencing practices of science education in schools (Aikenhead and Ogawa, 2007). Arab culture is believed to be suffused with Islamic paradigms, while Saudi science teachers are also influenced by traditional and constructivist views which in turn impact their instructional strategies (Haider, 1999). Science teachers' perceptions of the cultural factors influencing pupils' science learning were for the first time investigated from cross-cultural perspective in three countries.

Keeping in mind the fact that teaching is cultural transmission while learning is culture acquisition (Spindler, 1987; Wolcott, 1991), it is imperative to investigate the cultural factors influencing science education from a cross-cultural perspective believing that science education reform requires that both teachers and students should be aware of the cultural elements related to science education. According to Gurgel et al., (2016), previous studies highlighted that certain cultural factors such as religion and language represent major barriers to science learning and teaching. According to Dorsah and Okyer (2020), "cultural beliefs and taboos interfere with science teaching and learning and thus make the learning of science a difficult task for students" (p. 107). Arab students have difficulties in understanding cultural aspects related to science especially if those aspects are inconsistent with their Islamic values and beliefs (Haidar, 2002).

Although science learning is domain-specific learning, there are various cultural factors influencing it. Previous researchers have argued that cultural differences impose potential barriers to teaching and learning Science. A recent study conducted by (Wang et al., 2018) suggested that there are cross-cultural differences in science learning self-efficacy. For example, compared with Taiwanese students, US participants' self-confidence in their ability to utilise higher-order cognitive skills was found to improve their science learning self-efficacy. Numerous studies investigated factors affecting Science education in Saudi context (e.g., Alanazi, 2020, 2021, 2022; Saif, 2016), yet less research has focused on the potential influences of cultural factors on science learning and instruction.

Literature Review

"Science can be viewed as a cultural artefact" (Fisher and Waldrip, 1999, p.83). "Science is embedded in, and influenced by, society and culture" (Aikenhead, 1997a, p. 419). Haidar (1997) examined Arab prospective science teachers' presuppositions towards nature on spectra reflecting safety and fear, order, and chaos, the aesthetic and materialistic, the special and mundane. Participants mostly felt safe with regard to nature, which was seen as beautiful and special. The most significant finding was that teachers' presuppositions were mostly spiritual but not scientific nevertheless they would be science teachers soon.

Haidar (1999) investigated Emirates pre-service and in-service teachers' views about the nature of science. Five aspects of the nature of science were investigated: scientific laws, scientific method, scientific theories and models, role of a scientist, and scientific knowledge. Findings indicated that Emirates teachers' views are neither clearly traditional nor clearly constructivist.

Fisher & Waldrip (1999) developed and validated an instrument to assess culturally sensitive factors in the science learning environment. Additionally, it explored the association with the achievement of enquiry skills, and pupils's attitudes to science. Results indicated that collaboration, deference, competition, teacher authority and modelling dimensions were the most significant predictors of teacher-learner interpersonal behaviour while equity, competition, deference, modelling, and congruence factors were the most consistent predictors of learners' attitudes and achievement in science.

Aikenhead & Otsuji (2000) posited that learners' awareness of the cultural and cross-cultural factors influencing science learning and teaching is a key factor in science education reform. Accordingly, they compared some North American and Japanese science teachers' views on the cultural nature of school science in terms of its connection with their pupils' everyday cultures. In doing so, they examined the cross-cultural factors influencing science teachers' awareness of potential culture clashes in classrooms. Neither the Japanese nor North American teachers were very aware of a cross-cultural approach to teaching science for all.

Haidar (2002) found that secondary school science teachers in the United Arab Emirates believe that modern science is not a sub-culture of the Western culture and that Western cultural aspects are not implicitly incorporated in science education.

Keraro and Okere (2008) reviewed the empirical studies on the influence of culture on the learning of science in primary and high schools in Kenya and found that learners' cultural background is considered an essential obstacle that hinders science education in some African countries. Saif (2016) investigated the views of eighty-three Saudi science teachers about the nature of science. Findings indicated that the majority of the male and female teachers had similar misconceptions about most of the nature of science aspects.

Gurgel et al. (2016) reported a reflection on cultural identity in schools as an essential element influencing the mutual relationship between science content and students' learning. Results indicated that pupils became able to realise that science is not confined to certain concepts but rather deeper connections among different cultures can be initiated via science content. It is necessary to recognise science as a social activity which in turn is an important element for its promotion as part of the culture. Al-Ghamdi & Al-Maghrabi (2018) investigated science teachers' perceptions of the cultural factors influencing learning and teaching Science concepts in the primary school. Results indicated that the societal culture and parents' level of education had the highest impact on science education.

The covid-19 pandemic affected the patterns of social and psychological life (Khalaf, 2020), it affected education as well. According to Reiss (2020), it was possible to use school science to help in teaching about Covid-19 through employing biology lessons and mortality figures. Reiss argued that COVID-19 provided science teachers with the opportunity to increase learners' scientific literacy. A recent report conducted by the Public Policy Institute of California about impacts of Covid-19 on science education indicated that science education was derailed in most and became a lower priority activity, while other school subjects such as Mathematics and English language arts were given higher

priority. Even though schools were operating mainly in the virtual realm, there were teacher shortages and psychological burnout (Gao et al., 2022).

The Present Study

It is widely acknowledged that there are universal cultural constructs such as values and modes of behaviours that influence science education while every society has its own unique cultural characteristics that affect science learning and instruction as well. Most of the research regarding the role of cultural impacts on science learning and teaching has been conducted in Western countries. In view of this, the need for investigating the cultural factors influencing Science education in the Arab Gulf countries has been increasingly highlighted in recent years.

The cultural factors affecting Science instruction and learning should be widely investigated because this would enable students and teachers to cross the conceptual boundary between their cultural context and that of formal science. Curriculum developers should also consider the learners' cultural milieu. This would enable teachers to devise appropriate learning experiences that would allow learners to cross the conceptual bridge (Keraro & Okere, 2008).

The cultural differences are clearly reflected in two main elements: the framework of curriculum development and the delivery of scientific knowledge. Some Science education programmes developed in Arab countries are faded copies of those developed in Western settings. Scientific knowledge might differ or even contradict with Arab students' values and beliefs. this study focuses on comparing the perceptions of cultural factors affecting science learning and instruction in the KSA, Yemen and Egypt. Additionally, it explores the significant differences among Saudi, Yemeni, and Egyptian teachers concerning their perception of the cultural factors influencing Science teaching and learning. In this article, we assume that culture clashes occur for Middle East countries students whose science views might be affected by the cultural concepts embedded in the scientific world view conveyed by school science. The three countries have some cultural aspects in common as they are Arab countries and share the same language and religion except for Egypt in which there are large number of Coptic Christians. Science has been made a mandatory subject with an approved textbook for all primary and secondary schooling years. Science teachers' cultural outlook has been shaped from sub-cultures associated with an Islamic perspective and personal religious beliefs in relation to a Creator, humanity, empirical knowledge, and the meaning of life; the school subculture which encompasses instructional disciplines and systems; the culture of the society in which teachers live with reference to certain traditions and habits. Little previous research has addressed the cultural factors that underlie science learning and instruction in the Kingdom of Saudi Arabia (KSA), Yemen and Egypt.

Methods

A descriptive research method was adopted in this study. Inferential statistics (ANOVA and Scheffe post hoc test) were utilised to detect the difference among teachers from the three countries. The following cultural factors were investigated: (a) Nature of science, (b) science, culture, and community, (c) common everyday scientific knowledge, (d) science learning, (e) science and life reality, (f) science teaching and learning.

Research Questions

1- What are perceptions of science teachers of the cultural factors influencing science teaching and learning in KSA, Yemen and Egypt?
2- Are there significant differences among Saudi, Yemeni, and Egyptian teachers concerning their perceptions of the cultural factors influencing science teaching and learning?

The Study Group

The original population consisted of the science teachers in the middle schools in the three countries in the academic year 2019/2020. Three hundred participants were recruited to respond to the questionnaire. The questionnaire was sent to them electronically through e-mails as a Google form link. The response rate was 63.3%. The final sample consisted of 169 teachers from all countries as follows: KSA, (N=79, 12 females, 67 males), Yemen, (N= 53, 26 females, 27 males), and Egypt (N=37, 12 females, 25 males). The females in the entire sample were 50 (29.6%) while the males were 119 (70.4%).

Data Collection Tool

The items of the questionnaire were phrased after a thorough review of science education literature (e.g., Peregoy and Boyle, 1993; Ho, 2007, Maddock, 1981; Fisher and Waldrip 1999; Haidar 2002; Mansour, 2009). Items were written using Arabic and the final item pool was given to a panel of experts who were they invited to submit changes. A researcher from each country contacted the participants and distributed the questionnaire among the participants in the first semester of 2019/2020 year. The study utilised a questionnaire measuring the cultural factors influencing science teachers and learning in the selected countries. The process of instrument construction underwent the following steps: Reviewing the relevant literature on science teaching and learning and creating an item pool consisting of 48 items reflecting 6 potential cultural factors. Items were classified as follows: (a) nature of science (9 items), (b) science, culture, and community (12 items), (c) common everyday scientific knowledge (8 items), (d) science learning (9 items), (e) science and real-life (4 items), (f) Classroom science teaching and Learning (6 items). Modifications and corrections recommended by the panel members were implemented and the final version of the questionnaire consisted of 41 items.

Item total correlation was computed for the 41 items on scores of 30 teachers and the values of item-total correlation were reported in table 1. All correlation coefficients were significant at 0.01 level. Response categories ranged between strongly disagree 1 to strongly agree 5. Internal consistency was ensured via Cronbach's Alpha: (a) Nature of Science (8 items, α =0.786), (b) Science, culture and community (11 items, α=0.711), (c) common everyday scientific knowledge (7 items, α=0.698), (d) students' Science learning (7 items, α=0.703), (e) Science and real life(3 items, α=0.679), (f) Science Teaching and Learning (5 items, α=0.714). Cronbach's Alpha for the entire questionnaire was α=0.844. Taken together, these values indicate adequate internal consistency reliability (Khalaf & Abulela, 2021). Previous literature recommended to use McDonald's Omega side by side with Alpha in computing reliability because McDonald's omega is a robust measure of reliability (Khalaf and Abulela, 2021; Khalaf and Omara, 2022), it was computed and reported.

Statistical Analysis

Means and standard deviations were calculated. One-way ANOVA was used to detect the significant differences among the 3 samples in their perception of the cultural factors affecting science teaching and learning.

Findings

Table 1

Item-Total Correlation of the Questionnaire

Item	Correlation**	Item	correlation	Item	correlation	Item	correlation
1.	0.594	12.	0.643	23.	0.614	34.	0.689
2.	0.462	13.	0.508	24.	0.600	35.	0.817
3.	0.504	14.	0.554	25.	0.540	36.	0.698
4.	0.607	15.	0.681	26.	0.538	37.	0.624
5.	0.431	16.	0.516	27.	0.680	38.	0.692
6.	0.586	17.	0.511	28.	0.520	39.	0.501
7.	0.511	18.	0.564	29.	0.533	40.	0.644
8.	0.608	19.	0.608	30.	0.654	41.	0.434
9.	0.535	20.	0.552	31.	0.527		
10.	0.545	21.	0.610	32.	0.548		
11.	0.598	22.	0.561	33.	0.604		

*Note.** All values were significant at $p \leq 0.01$ level.

Table 2

Means and Standard Deviations of the Second Sub-Scale (Nature of Science)

	Items	Saudi Arabia (79)		Yemen (53)		Egypt (37)		Total (169)	
		M	SD	M	SD	M	SD	M	SD
1.	Science discovers existing phenomena	4.46	0.676	4.32	0.754	4.65	0.588	4.46	0.690
2.	Science devises modern devices such as artificial hearts, computers, and spaceships	4.47	0.676	4.34	0.876	4.41	0.686	4.41	0.744
3.	Science makes people's life better than before	4.72	0.530	4.47	0.799	4.27	0.838	4.54	0.715
4.	Scientists use modern knowledge to make discoveries	4.32	0.793	4.15	0.886	4.43	0.835	4.29	0.834
5.	Science is the basis of modern technologies	4.68	0.544	4.58	0.719	4.00	1.179	4.50	0.817
6.	Technology develops autonomously with no scientific basis	2.20	1.067	1.91	0.904	2.95	1.413	2.27	1.164
7.	Science presents a comprehensive perspective of natural phenomenon	4.00	0.768	3.70	0.972	4.05	0.880	3.92	0.869
8.	Science interprets the odds of nature	4.11	0.920	4.08	0.851	4.08	1.090	4.09	0.934
	Total	4.12	0.404	3.94	0.439	4.11	0.292	4.06	0.400

Table 3

Means and Standard Deviations of the Second Sub-Scale (Science, Culture, and Community)

	Items	Saudi Arabia (79)		Yemen (53)		Egypt (37)		Total (169)	
		M	SD	M	SD	M	SD	M	SD
1.	Scientific facts are consistent with common sense in our community	3.11	1.038	2.89	0.913	3.14	1.228	3.05	1.045
2.	scientific knowledge is distinct from Arab culture	2.91	1.076	2.64	1.002	2.95	1.490	2.83	1.158
3.	It is easy to integrate personal views into scientific	3.48	0.985	3.21	1.007	3.46	1.043	3.39	1.007

	Items	Saudi Arabia (79)		Yemen (53)		Egypt (37)		Total (169)	
		M	SD	M	SD	M	SD	M	SD
	knowledge								
4.	Science is a part of Western culture	2.65	1.271	2.55	1.280	3.22	1.397	2.74	1.320
5.	Scientific knowledge dominates individual's way of thinking	4.01	0.824	3.77	0.993	3.19	1.244	3.76	1.027
6.	Science distorts values, traditions, and customs.	2.29	1.134	2.09	0.925	2.76	1.480	2.33	1.179
7.	Sciences are universal and develop in similar way regardless of nationalities of scientists	3.62	1.158	3.72	1.099	3.05	1.373	3.53	1.210
8.	Science reflects community values and beliefs	3.66	1.036	3.36	1.111	3.54	1.260	3.54	1.113
9.	Natural events have both scientific and cultural interpretations	3.71	1.052	3.53	1.030	3.59	0.956	3.63	1.022
10.	Science helped some countries to conquer other countries	3.77	1.154	3.70	0.972	3.43	1.281	3.67	1.132
11.	Western values and beliefs are implicitly incorporated into science	2.82	1.107	2.36	0.982	3.27	1.239	2.78	1.143
	Total	3.28	0.548	3.07	0.541	3.24	0.642	3.20	0.572

Table 3 shows that teachers in the three countries believe that science enables novel discoveries about the universe and interprets natural phenomena. Additionally, it is generally held that science improves people's lives. However, the mean scores of Yemeni teachers were lower than those of their Saudi and Egyptian counterparts. Although all teachers in the sample consider that most technological advances are based on scientific evidence, Egyptian teachers were not likely to believe in the interconnection between science and technology compared to the Saudi and Yemeni teachers. Moreover, Yemeni teachers believed that science invents new devices such as spaceships, computers, and artificial hearts. Teachers in the three countries reach a consensus that science and culture are correlated and have some things in common. As seen in item no.3, teachers consider that science in any society does reflect its dominant culture and values.

Table 4

Means and Standard Deviations of the Third Sub-Scale (Common Everyday Scientific Knowledge)

	Items	Saudi Arabia (79)		Yemen (53)		Egypt (37)		Total (169)	
		M	SD	M	SD	M	SD	M	SD
1.	There is a great gap between science concepts and everyday life occurrences	3.41	1.019	3.08	1.016	3.24	1.535	3.27	1.152
2.	Evidence-based scientific proofs differ from common sense	3.19	0.988	3.06	0.908	3.41	1.212	3.20	1.019
3.	Evidence-based scientific proofs and common sense are interpreted in a similar manner	2.82	1.071	2.45	0.889	3.05	1.615	2.76	1.178

	Items	Saudi Arabia (79)		Yemen (53)		Egypt (37)		Total (169)	
		M	SD	M	SD	M	SD	M	SD
4.	Scientists and science teachers use common sense to support scientific knowledge	3.99	0.870	3.64	0.922	3.59	1.092	3.79	0.950
5.	Scientific interpretation of natural phenomenon is consistent with commonsense	3.05	0.973	2.96	0.919	3.24	1.140	3.07	0.995
6.	Scientific interpretation of natural phenomenon is consistent with that of common sense	3.43	1.288	3.04	1.224	3.38	1.299	3.30	1.275
7.	Cultural groups learn in different ways.	3.53	0.875	3.13	0.962	3.22	1.228	3.34	0.999
	Total	3.35	0.538	3.05	0.528	3.31	0.712	3.24	0.589

As shown in table 4 a wide gap is perceived between science concepts and everyday life activities. Scientific interpretation of natural phenomenon is different from the societal one as reported by teachers in the three countries. Teachers agreed upon the existence of two interpretations of natural phenomena, namely the scientific interpretation. This duplicate understanding has a bad effect on science instruction because students will face two contradictory interpretations of the same phenomenon. Cultural groups, in the participants' points of views, learn science using fundamentally different ways. Science teachers moderately agreed that scientific evidence does not necessarily reflect the common sense.

Table 5

Means and Standard Deviations of The Third Sub-Scale (students' Science learning)

	Items	Saudi Arabia (79)		Yemen (53)		Egypt (37)		Total (169)	
		M	SD	M	SD	M	SD	M	SD
1.	School students prefer to learn science individually	2.84	1.031	2.34	0.876	4.05	1.053	2.95	1.166
2.	Students should learn science via teamwork	4.11	0.906	4.13	0.981	4.00	1.155	4.09	0.983
3.	Students should be autonomous and take decisions in learning science	3.62	1.090	3.28	1.007	3.73	1.239	3.54	1.107
4.	It is important for students to share in science classroom discussions	4.51	0.677	4.60	0.817	3.59	1.301	4.34	0.969
5.	Students do what science teachers expect rather than their own work	3.16	1.245	2.94	1.045	3.54	1.386	3.18	1.231
6.	Students attempt to answer all scientific questions	3.92	0.984	3.81	0.856	3.32	1.270	3.76	1.038
7.	There is a weak link between school learning and home assignments	3.89	1.050	3.58	1.064	3.30	1.469	3.66	1.175
	Total	3.72	0.489	3.53	0.411	3.65	0.541	3.65	0.483

Students' responses, as depicted in table 5, reflect that teamwork is substantially beneficial compared to individual learning style because group learning enable them to positively share in classroom discussions. Students in the investigated countries are obliged to memorise what they have learned from the teacher rather initiate to give their own thoughts and personal view points these comments apply to any subject, not just school science.

Table 5

Means and Standard Deviations of The Fourth Sub-Scale (Science and real life)

	Items	Saudi Arabia (79)		Yemen (53)		Egypt (37)		Total (169)	
		M	SD	M	SD	M	SD	M	SD
1.	Scientific concepts learnt in schools differ from those of home	3.66	0.973	3.42	1.027	3.51	1.070	3.55	1.011
2.	There is little connection between knowledge and real-life in teaching science	3.67	1.009	3.53	1.103	3.38	1.421	3.56	1.138
3.	Lack of parents' awareness and assistance in their children's Science learning	3.99	0.899	4.02	0.909	3.43	1.168	3.88	0.989
	Total	3.77	0.711	3.65	0.798	3.44	0.832	3.66	0.772

Table 5 shows that Scientific concepts presented to students in the schools are very different from those delivered by parents at home which in turn leads to a weaken the association of scientific knowledge and the actual realty of students' life and day-to-day situations.

Table 6

Means and Standard Deviations of the Fourth Sub-Scale (Science Teaching and Learning)

	Items	Saudi Arabia (79)		Yemen (53)		Egypt (37)		Total (169)	
		M	SD	M	SD	M	SD	M	SD
1.	Teaching science focuses on students' role in reaching knowledge on their own	3.72	1.049	3.53	1.030	3.51	1.146	3.62	1.063
2.	Science concepts taught in schools reflect dominant community culture	3.13	1.102	2.85	1.045	3.57	1.237	3.14	1.139
3.	Science curricula impose certain foreign cultural values	2.81	1.133	2.25	0.757	3.54	1.260	2.79	1.154
4.	The essential responsibility of science teachers is to prepare students for university study	3.29	1.123	3.49	1.203	3.86	1.110	3.48	1.160
5.	The science teacher's main duty is to implant autonomous thinking skills in students	4.37	0.922	4.51	0.576	3.95	0.941	4.32	0.855
	Total	3.46	0.677	3.32	0.559	3.69	0.573	3.47	0.630

Table 6 shows that teachers believe that science education should mainly focus on students' roles in searching for scientific knowledge on their own. They moderately agree that science concepts taught in schools reflect the dominant community culture. They do not agree that science curricula impose certain Western cultural values. They completely agree that the Science teacher's main duty is to implant autonomous thinking skills and independent learning in students.

Table 7

Descriptive Statistics on the Six Subscales

	Sub-scales	Saudi Arabia (79)		Yemen (53)		Egypt (37)	
		M	SD	M	SD	M	SD
1	Nature of science	4.12	0.403	3.94	0.439	4.10	0.292
2	Science, culture, and community	3.28	0.548	3.07	0.541	3.24	0.642
3	Common everyday scientific knowledge	3.35	0.538	3.05	0.528	3.31	0.712
4	Students' science learning	3.72	0.490	3.53	0.411	3.65	0.541
5	Science and life reality	3.77	0.711	3.65	0.798	3.44	0.832
6	Classroom science teaching and learning	3.46	0.678	3.32	0.559	3.69	0.573

Table 8

Results of One-Way ANOVA for the Difference among Countries

Sub-scales		Sum of Squares	df	Mean Square	F	P
Nature of Science	Between Groups	1.081	2	0.541		
	Within Groups	25.798	166	0.155	3.478	0.033
	Total	26.879	168			
Science, culture, and community	Between Groups	1.348	2	0.674		
	Within Groups	53.537	166	0.323	2.090	0.127
	Total	54.885	168			
common everyday scientific knowledge	Between Groups	2.920	2	1.460		
	Within Groups	55.301	166	0.333	4.382	0.014
	Total	58.220	168			
Students Science learning	Between Groups	1.185	2	0.592		
	Within Groups	38.044	166	0.229	2.585	0.078
	Total	39.229	168			
Science and life reality	Between Groups	2.762	2	1.381		
	Within Groups	97.458	166	0.587	2.352	0.098
	Total	100.220	168			
Classroom Science teaching & Learning	Between Groups	2.859	2	1.429		
	Within Groups	63.785	166	0.384	3.720	0.026
	Total	66.644	168			

Table 8 shows that Saudi teachers' awareness of the influences of the cultural factors on science education was higher than that of the Egyptian and the Yemeni teachers. There were significant differences for nature of science, common everyday scientific knowledge, classroom science teaching and Learning) while there no significant differences for science, culture and community, Students Science learning, and Science and life reality). The Scheffe post hoc test was used to detect the direction of the significant differences. Results of the post hoc test are reported in table 9.

Table 9

Multiple Comparisons Using Scheffe Test

Sub-scales	Country		Mean Difference	P
Nature of science	KSA	Yemen	0.18*	0.04
		Egypt	0.02	0.98
Common everyday scientific knowledge	KSA	Yemen	0.30*	0.02
		Egypt	0.04	0.94
Classroom science teaching & learning	Yemen	KSA	-0.14-	0.45
		Egypt	-0.36-*	0.02

Table 9 shows that Saudi and Egyptian teachers were apparently more aware of the cultural factors related to science education than Yemeni Teachers while there were insignificant differences between Saudi and Egyptian teachers regarding the cultural factors influencing Science education.

Discussion

There was also a lack of congruence between formal science learning in schools and everyday life deployments of science. Certain scholars have claimed that when science curricula are imposed by international organisations, they tend to be western-centric and therefore in conflict with local scientific cultures and identities.

No key differences between science teacher perceptions of the role of cultural factors in shaping science learning and teaching were identified at the country level. Across all three countries the results were similar, and this may be due to the fact that they share relatively common value systems, sets of attitudes and norms, notions of science culture and curricula, and institutions for teacher training and schooling. Overall, with the role of science in explaining natural phenomena, the relation between science and society, the importance of the scientific community and the role of science in daily life being viewed as positive aspects of education and society. Abd-El-Khalick and BouJaoude (1997) found in their study of secondary-level science teachers in Arab states that a significant majority of their participants possessed inaccurate and inconsistent conceptions of certain NOS aspects, such as the importance of distinguishing between observation and inference, the role of theory in scientific enquiry, and the importance of methodical, standardised scientific methods.

There is a paucity of studies of Saudi Arabian contexts in terms of teacher conceptions of the nature of science (Saif, 2016). The findings here have identified that the teachers possess relatively consistent conceptualisations regarding most NOS aspects, with, concomitantly, no differences between male and female teacher conceptions. To discern teacher conceptions of the scientific method, scientific theories and laws and the roles of scientists in collecting evidence and explaining natural phenomena, Haider (1999) studied both trainee and working teachers in the United Arab Emirates. The teachers in this study expressed neither traditionalist NOS perceptions nor 'constructivist' ones. The participants in the present study did certain tensions between science, society, and culture, but overall, a consensus emerged (across all three country-specific teacher groups) that science does not fundamentally isolate learners from their cultural values and norms. It is, accordingly, plausible to teach children science from an early age in these Arab countries. A broad consensus was also expressed that science teaching strategies can and should enable autonomous learning and student-led knowledge acquisition. The teachers were clear that learners are able to identify how important science is as an explicatory method for understanding the world and how vital science is in society. Culture and science can, accordingly, exist in relative harmony.

Haidar (1997) contends that science teacher ideational systems and worldviews pertaining to the nature of science, shaped by Arab cultural norms and values, can affect science learning. Saif (2016) states that Saudi Arabian science teachers should be provided with adequate and regular

training and continuing education. A disjunct between scientific concepts and methods and socially contextual modes of interpretation of the same phenomena can arguably negative impact on science teaching and learning.

Mansour (2009) contends that in Egypt, where foreign organisations have been in charge of reforming the science curriculum, On the other hand, other scholars have found the opposite, however. Haidar (2002), for example, has found that secondary-level science teachers in the Emirates perceive scientific concepts as congruent with personal and collective cultural ideas. In Haidar's (2002) study, teachers expressed the view that Arabic societal ideas are not eschewed by the teaching of science, and that science teaching does not necessarily comprise an imposing project from abroad. This study therefore suggested that Arab culture and modern science were ultimately compatible in the real world.

In his investigation into the performance of the western science curriculum as practised in the Aydarova (2012) argued that students' cultural environments and normative contexts must be factored into the use of the western curriculum. For example, issues such as premarital pregnancy can be thought of as offensive in conservative Islamic contexts.

Ogawa (1989) studied science curricula in Japan and found that the primary-level curriculum, premised on Japanese concepts of love of nature, encountered no cultural conflicts, but the secondary-level one, premised on western science, faced significant difficulties. Explorations of the deployment of western scientific curricula and teaching methods in Arab contexts are limited in number and range in the literature, and, as noted by Abd-El-Khalick et al. (2008), further research into the ways that the NOS is portrayed in science materials such as textbooks is imperative (see also Vesterinen et al., 2013). The formal science textbooks used in Saudi Arabian learning settings convey only one method of scientific investigation (Saif, 2016).

Alabdulkareem (2016) has found that Saudi Arabian science teachers often face difficulty in making their science learning congruent with their own cultural beliefs and backgrounds, exacerbated by a dearth of confidence in dealing with this tension. The two remain incongruent, with science and historically contextual cultural values existing in an ongoing conflict. The teachers studied herein were not used to engaging in deliberation over the connections between the natural sciences and local student beliefs and values.

Science textbooks in Arabic countries may thus benefit from incorporating discussion of the different methods for science knowledge acquisition (Saif, 2016). This study suggests how important it is that Arab students learn science in a secure and comfortable environment, whereby they can comprehend the subject matter and relate this to their everyday experiences and culturally contextual modes of explaining the natural world. It accordingly follows that education departments and ministries in the Arab world would benefit from delivering training and continuing professional development courses that can make western science teaching and local, culturally contextual knowledge and values consistent and compatible. Teacher training designers targeting in-service teachers would do well to incorporate these findings into their considerations. An implication of this study is that teachers should be resilient (Khalaf and Al-Said, 2021), especially science teachers ought to be resilient in accepting and correcting students' cultural misconceptions about science in classrooms.

Conclusion

This study found that the teachers broadly speaking concurred that science learning and teaching, the nature of science, science in relation to culture and community and science education in classroom contexts interrelated with cultural factors positively. Conversely, the study also found that the teachers felt that science and common sense, student science learning and science and everyday life all interacted negatively or did not interact significantly with cultural factors. The former three were evidently connected to teacher attitudes and beliefs, whilst the latter three emerged from student, familial and societal sources.

Limitations

The sample of this study is limited to teachers in Saudi Arabia, Egypt, and Yemen, so further investigation in other Arab countries would enable researchers to better understand the role of cultural factors in influencing science learning and teaching. Additionally, future research should investigate other educational levels, including primary and higher education settings. Our study was dominated by females; thus, further research should consider a balanced sample in the percentage of males and females. Previous literature (e.g., Khalaf and Alshammari, 2023) posited that the use of a structured interview and self-report questionnaire will be very useful to enhance a wider scope of the study. Our study used solely a self-rating questionnaire; thus, future studies should use mixed methods approach. Further validation of the questionnaire using exploratory and confirmatory factor analysis is needed to extract pure principal component factors (Khalaf, 2016, 2017). Since motivation plays a main role in learning (Abdelrasheed and Khalaf, 2022; Abdelrasheed, et al. 2023), cultural factors influencing Science education should be studied within a motivational perspective. As social networking sites and online learning are widespread nowadays (Shehata et al., 2023a, 2023b), further studies should examine students' digital ethics and science misconception and misinformation.

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