

AFRICAN TEACHER EDUCATORS' VIEWS AND UNDERSTANDING ABOUT SCIENCE, CULTURE, AND TEACHING AND LEARNING OF SCIENCE

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ABSTRACT

The study explored teacher educators' views on science, culture, and the connection between science and culture, and secondly on their understanding of teaching and learning science. A total of 32 teacher educators from Kenya, Africa responded to the Science and Culture Questionnaires. The questionnaire was adapted from Aikenhead and Huntley's (1997) study to address the broad relationship of science and culture among senior Kenyan teacher educators. Focus group discussions and individual interviews were conducted to explore their understanding of teaching and learning science. These approaches were intended to reveal the teacher educators' views being consistent with or disagreeing with the commonly held worldviews of science as portrayed in media and science education literatures. The results showed that the teacher educators had relatively similar views with respect to the five aspects of the questionnaire. A greater variance was only observed on the mean scores on two aspects, namely Science and Everyday Common Knowledge and in Teaching and Learning Science. No statistically significant difference was noted when the teacher educators' views were categorised according to the length of teaching experience and subject specialisation. The statistically significant difference on their views was only found in the Science and Culture scale when they were grouped according to gender. The findings from the Focus Group Discussions (FGD) and interviews conducted separately in groups showed teacher educators discriminate with respect to different aspects of Culture and Science, however, were not against the application of technology for scientific advancements.

Key words: Science and culture; teachers' views and beliefs; focus group discussion (FGD)

INTRODUCTION

The richness of the science classroom includes laboratory activities that students perform, the instruments and equipment students are encouraged to use, and the science projects including the field activities related to everyday life. All of these are largely under the supervision and control of the teacher. Most often the instruction in science and mathematics as core subjects of the curriculum are closely regulated by Education Ministries. Schools follow a prescribed

curriculum and the teachers commonly implement priorities concerning material to be covered in depth, which ones to be given more emphasis and which to be omitted.

Fraser and Tobin (1996) describe a classroom environment as the organisation and order that the teacher establishes in the science curriculum as well as the teacher's involvement in the classroom. Teaching of science varies considerably across classrooms in frequency, scope, and intensity. However, to teach science as portrayed by the standards, teachers must have theoretical and practical knowledge about science learning and science teaching.

There is a significant body of research reporting about epistemological beliefs and learning. These views influence individuals on how to deal with competing knowledge claims, evaluating newly introduced information and the making of decisions that affect their own lives and the lives of those in their sphere of influence (Hofer, 2000). The studies of Weiss, Banilower, MacMohan and Smith (2001) cited teachers in various grade levels spending varied amount of time for preparation reading instructions each day. Studies show that among elementary science teachers only 9% reported feeling adequate to teach science (Tilgner, 1990). Elementary teachers also consider themselves poorly prepared to teach concepts of science or manage a class engaged in hand-on activities (Weiss, et al., 2001). A few recent studies also define several factors that influence teachers' choices concerning their instructional methods and contents of science teaching.

Many factors including the teachers' knowledge of science content, previous practical experiences with science, and views of science teaching and learning have influenced their choices and practices (Farrow, 1999; Prawat, 1989). Increasingly, teachers' length of experience has been recognised as a foundational factor that affects how science is taught. Since teachers are also former science students, their mentors may have affected their choices as science teachers. Teachers' past mentors may have influenced both how science is taught and learned.

THEORETICAL FRAMEWORK

The emergent or dynamic nature of human social interactions is recognized in the application of “grounded theory” (Glaser & Strauss, 1967, p.43). In its simplest term, grounded theory is the generation or construction of a theory from the data during the research process. Grounded theory is an interactive process as the researchers engage in joint collection, coding, and analysis of data (Glaser & Strauss, 1967). The theory emerges concurrently with the unfolding of the actions and events in the situation being studied and further, as data are collected; the researcher aims to clarify, to revise and ultimately to refine categories until elements of a theory are well developed. Glaser and Strauss (1967, p43) describes the coding method as “constant comparison” and the evolving data collection decisions as theoretical sampling. This approach to the generation of a theory also recognises the unpredictable nature of human activity. It allows for fluidity of approach, for the possibility of change in almost any aspect of the research without requiring that the researcher abandon it and start all over again (Strauss & Corbin, 1998a; 1998b). The researcher is freed from the confinement of entering the study with predetermined theoretical assumptions to be proven (Sarmiento, 2005).

This study is guided by the models of Spindler (1987) and Wolcott (1975) that adopts the views of science teaching as cultural transmission and learning as cultural acquisition. This is from the notion that science tends to be a Western cultural icon of prestige, power, progress and privilege; its culture tends to permeate the culture of those who engage it, and cultural assimilation is the possible consequence (Aikenhead, 1997). Research shows that students can also avoid cultural assimilation by playing a “game” that allows them to pass a science course without really understanding the content (Costa, 1995). This game played by students is often referred to as the “Fatima Rules” where it is likely that they take the information and memorize as much as they can without actually learning (Aikenhead & Jegede, 1999; Larson, 1995). Students do not learn in any meaningful way; only the communicative competence occurs instead of meaningful learning (Kelly & Green, 1998) for the purpose of getting through a course (Costa, 1995).

Ultimately, there is a need to find out how teachers understand science in connection with their teaching and students' learning where students' cultural background differed from the culture of western science taught in the classrooms. It is essential to explore to what extent the teachers are able to provide connectedness of their cultural practices to everyday experiential life in their science teaching.

This paper aims to understand the underlying views of experienced teacher educators about culture and science, and the teaching and learning of science and how these beliefs are embedded in their practices. Beliefs do not lend themselves easily to empirical investigations. Teachers may not be able to accurately or adequately represent their beliefs; consequently beliefs could not be consequently observed. Although it is not observed, beliefs can be inferred from what people think and say, intend and do (Pajares, 1992). Evidence on this view includes brief statements, and what a person says is included in the assessments of beliefs. In this study, to elicit the teachers' views, focus group discussions were also conducted together with semi-structured informal interviews. The data were analysed from the perspectives of grounded theory approach.

AIMS OF THE STUDY

The ultimate aim of this study was to examine the views of Kenyan teacher educators about science and culture, the teaching and learning of science and how these views influence their teaching. More specifically, this study was guided by the following research questions:

1. What are the Kenyan teacher educators' views of science, culture, and teaching and learning of science?
2. What are their understanding on the connectedness of science and culture?
3. Are there any significant differences between the teacher educators' views and understanding of science according to gender, areas of specialisation, and years of teaching?

METHODOLOGY

This study was divided into two phases. First, a questionnaire survey was conducted to answer Research Questions 1 and 3. The second part of the study was an exploratory phase aimed to validate the findings from the teacher educators' views of science, culture and the teaching and learning of science obtained from the questionnaires. In so doing, this study employed semi-structured informal interviews and Focus Group Discussions using the grounded theory approach. The teacher educators' responses to the interview questions served as sources of data to answer the research questions. The questions during the interview were structured to illuminate the teacher educators' cultural background and experiences emphasizing culture context to the expression of their science beliefs and pedagogy. Statements of each item in the questionnaire are presented in the Result and Discussion section.

Research Design

The study employed the causal comparative design. This was found appropriate because the investigation compared the views of different independent groups. The study was non-experimental with no manipulation in the independent variables because their manifestations had already occurred (Cohen & Manion, 1994; Kerlinger, 2000; Nachiamas & Nachiamas, 1996). The study further explored the use of focused group discussions, semi-structured interviews as well as informal interviews to validate the quantitative findings.

Sample

Setting and Participants. As reflected in Table 1 below, the respondents of the study were African science teacher educators. These were senior teacher educators residing in all the six major provinces of Kenya, attending a one-month training course at RECSAM. Purposive sampling was done as they were already well selected by the Kenyan government from 32 teacher colleges.

Table 1
Participants' Profiles (N=32)

Category	Gender		Total	Percent
	Male	Female		
Subjects Specialisation				
Science and others	7	6	13	40.6 %
Science	9	1	10	31.3 %
Mathematics	2	0	2	6.3 %
Mathematics and others	7	0	7	21.9 %
Total	25	7	32	100 %
Age				
Below 41	5	2	7	21.9 %
42-45	6	4	10	31.3 %
46-50	14	1	15	46.9 %
Total	25	7	32	100 %
Official Designation				
Head	8	2	10	31 %
Senior lecturer	13	5	18	56.3 %
Principal lecturer	3	0	3	9.4 %
Dean	1	0	1	3.1 %
Total	25	7	32	100 %
Length of Teaching Experience				
Less than 10 years	1	0	1	3.1 %
10-15 years	3	2	5	15.6 %
16-20 years	13	4	17	53.7 %
21 years and above	8	1	9	28.1 %
Total	25	7	32	100 %
Province /Location				
Central	3	1	4	12.5 %
Eastern	1	1	2	6.3 %
Rift Valley	10	2	12	37.5 %
Nyanza	2	0	2	6.3 %
Coastal	3	0	3	9.4 %
Western	1	0	1	3.1 %
Others	5	3	8	25 %
Total	25	7	32	100 %
Mother Tongue				
Kikuyo	7	3	10	31.3 %
Luhya	1	2	3	9.4 %
Dholvo	1	0	1	3.1 %
Lou	4	1	5	15.6 %
Kipsilis	1	1	2	9.4 %
Tugen	1	0	1	3.1 %
Pokot/Kalingin	2	0	2	9.4 %
Kikamba	1	0	1	3.1 %
Kimero	1	0	1	3.1 %
Ekegusii	3	0	3	9.4 %
Nandi	1	0	1	3.1 %
Total	25	7	32	100 %

Table 1 provides the biographical data of the respondents. It shows that a majority of the respondents were dominated by males (25 or 78%); with only 7 or 22% females. Most of the participants (23 or 72%) specialised in teaching Science only (10 or 31.3 %) and Science and Agriculture (13 or 40.6 %). Two of the respondents (6.3%) had purely mathematics background and seven of them (22%) specialised in teaching mathematics, science, counseling and others.

The teacher educators were neither below 37 years old nor above 50 years old. The ages of the teacher educators ranged from 41 to 50 years old.

With regard to the teacher educators' designation and length of experience, the largest numbers of respondents were senior lecturers (18 or 56.3 %) in most of the teacher training centers, followed by those who headed their departments (10 or 31 %). Three respondents (9.4%) were principal lecturers, and only one held the deanship. About half (17 or 53.7 %) had taught for 16 to 20 years and about one third (9 or 28.9%) taught above 21 years. Five respondents (15.6 %) had already taught for the last 10 years; and only one person had less than 10 years teaching experience.

Table 1 also summarizes the distribution of the teacher educators across the six major provinces of Kenya. The majority of the respondents were from Rift Valley (12 or 37.5 %); followed by the relatively same frequency of respondents representing the other four provinces, namely, Central (4 or 12.5 %); Easter and Nyanza (2 or 6.3 %); and Coastal (3 or 9.3 %). Western Kenya (1 or 3.1 %) was represented the least.

From the teacher educators' dialects spoken at home, a majority of them (10 or 31.3 %) spoke Kikuyo, followed by Lou native speakers (5 or 15.6 %) and with almost equal frequencies (3.1% to 9.4 %) for other dialects as shown in Table 1. Swahili was the major language spoken by the all the African teachers from Kenya.

Data Sources. The questionnaire survey, the FGD as well as the semi structured interviews were used as the major methods of data collection.

Questionnaire. The questionnaire that was adapted from Aikenhead and Huntley's (1997) study was administered to the 32 Kenyan teacher educators towards the second week of their training course programme. The questionnaire consisted of five main constructs or aspects with a total of 41 items using a five-point Likert scale for responses: Strongly Disagree, Disagree, Undecided,

Agree, and Strongly Agree. Each item was scored 1 to 5; in which score 1 indicated strongest disagreement toward the statement of the item; whereas 5 referred to the most positive views or strongest agreement toward the item. The original questionnaire was tested for reliability using Cronbachs' alpha coefficient to determine the internal consistency of the items; and it was found that the questionnaire possessed an alpha coefficient of 0.97. This score is considered respectable and desirable for consistency levels (Henerson, Morris & Fitz-Gibbon, 1987; Koul, 1984). In the present study, it was confirmed that all scales in the adapted questionnaire possessed Cronbach alpha reliability of more than 0.50. It was suggested that in a case of an exploratory research such as this study, a reliability of 0.50 was acceptable (McMillan & Schumacher, 1993).

Interviews and Focus Group Discussions (FGD). Following the administration of the questionnaire, a semi-structured interview was conducted to ten participants who were selected based on their willingness to answer questions during the four week training. The interview was structured so as to allow the interviewer to probe for clarification, justification or to respond to the intensity of the interviewee's response (Guba & Lincoln, 1981). The time for the interviews ranged from an average of 45 minutes to one hour. In addition to the informal interviews, three separate FGD were arranged after their training sessions to further elicit their understanding collectively about teaching and learning of science. Through the use of multiple methods of data collection outlined previously, mixed components were available for triangulation. Le Compte and Preissle (1993) described triangulation as a means that the researcher uses to pinpoint the accuracy of conclusions drawn during the data analysis. Triangulation prevents the researcher from accepting initial impressions too readily. Miles and Huberman (1984) described triangulation as a state of mind, whereby "If you self-consciously set out to collect and double check findings, using multiple sources and modes of evidence, the verification process will largely be built into data gathering process, and little more need be done than to report on ones' procedures" (p. 235).

Limitations of the Study. There were limitations evident in the conduct of the study. Firstly, the selection of the teachers was based on the number of participants who attended the training programme. Secondly, the length of the interviews to deal in more depth with each individual was not adequate due to time constraints. Instead the Focus Group Discussions were conducted to compensate for a deeper context of a general paradigm. Nevertheless, this study may contribute to the body of knowledge concerning teachers' views on culture, science, and teaching and learning of science.

Data Analysis. Data for the questionnaires were analysed across groups using descriptive statistics to describe teacher educators' views in all the five aspects namely, *Science, Science and Culture, Culture, Science and Everyday Knowledge* and *Teaching and Learning Science*. A t-test was done as the basis of comparison on the five aspects of the questionnaire scales; to check significant differences of the mean scores for gender, subject specialisation and length of teaching experience. For the qualitative aspects, the coding and distribution of the data employed the strategy described by Miles and Huberman (1984). A matrix was developed for each of the interview questions, with a row for each teacher participating in the interviews. The first column was labeled 'responses' with the other column labeled as 'comments'. The researcher's comments were also recorded in the transcripts when more than one teacher educator used similar phrases or expressed a thought or idea similar to what another teacher educator conveyed. These similar responses formed the basis for emerging patterns of teacher educators' responses. In the stage of analysis, categories were generated on the patterns of responses using the data matrices. Responses with common or similar responses formed the basis of the findings from the analysis.

Results and Discussions

In response to Research Question 1, the teacher educators' views about *Science, Science and Culture, Culture, Science and Everyday Knowledge* and *the Teaching and Learning of Science*

are summarized in Tables 2. Table 2 also provides Cronbach alpha reliability for each scale and teacher educators' views on each scales as indicated by the mean scores and standard deviations.

Table 2
Cronbach Alpha, Mean and Standard Deviation of Each Scale (N = 32)

Scale Name	Total Items	Cronbach Alpha	Mean	SD
Science	8	0.58	4.05	0.39
Science and Culture	12	0.55	3.37	0.49
Science and everyday common knowledge	6	0.53	3.74	0.61
Culture	7	0.50	3.83	0.49
Teaching and Learning Science	8	0.61	3.74	0.63

Generally, as shown in Table 2 the Kenyan teacher educators possessed a relatively high perception toward all scales with mean scores ranging from lowest of 3.37 (Science and Culture) to the highest of 4.05 (Science). These scores designate the degree of agreement toward the scale's content varying from agree to strongly agree. The variance of the teacher educators' response was greater for two scales, namely *Science and Everyday Common Knowledge* and *Teaching and Learning Science*, as indicated by their relatively high standard deviations, 0.61 and 0.63, respectively.

Teacher educators were in agreement towards definitions of science as stated in all items in the *Science* scale. The scale's mean and the standard deviation were 4.05 and 0.39, correspondingly. This implies that the respondent gave their response ranging from 3.66 (slightly agree) to 4.45 (somewhat strongly agree). Table 3 provides the detail of the teacher educators' responses toward this aspect.

Similar perceptions were held by the Kenyan teacher educators toward the three scales, namely *Science and Everyday Common Knowledge*, *Culture*, and *Teaching and Learning Science*. On average, the teacher educators showed their disagreement or were undecided on the items in the *Teaching and Learning Science* scale (mean score 3.11); and agreed on the item statements in the *Culture* scale (mean score 4.31). On the other hand, teacher educators' views on the Culture aspect are fairly low, mean scores ranging from 2.88 to 3.88, which indicated somewhat their non-confident opinion toward the definition of culture. Table 4 to 7 elaborate the teacher

educators' views on four scales: *Science and Everyday Common Knowledge*, *Culture*, and *Teaching and Learning Science*.

Teacher educators' views on Science

Table 3 presents the mean scores and standard deviation of each item of the first scale of the questionnaires.

Table 3
Mean scores and Standard Deviation on Science (Item 1 to 8)

No	Item Responses	Mean	SD
1	Science is exploring the unknown and discovering new things about our world and the universe and how they work	4.56	0.50
2	Science is inventing or designing things (for example, artificial hearts, computers, space vehicles)	2.28	1.11
3	Science is finding and using knowledge to make this world a better place to live in (for example: curing disease, solving pollution, and improving agriculture).	4.66	0.48
4	Science is an organization of people (called scientist) who have ideas and techniques for discovering new knowledge	4.00	1.00
5	Science is the basis of most technological advances.	4.72	0.45
6	Technology does not need to have scientific basis, technology can advance on its own know-how *)	4.53	0.91
7	Science represents a holistic/comprehensive perspective about natural phenomena.	3.53	1.10
8	Science provides the most plausible explanations of natural phenomena.	4.10	0.70
Grand mean		4.05	0.39

In this scale, the highest and lowest means were reflected on item 5 and item 2, respectively. The respondents showed strong agreement that science is the basis of most technological advances (Item 5), but on the other hand they also had strong disagreement for item 2, which stated that science is just a way of inventing or designing things. For the other six items, the mean scores were higher than 3.53 revealing the teachers' positive views of Science. Overall, the grand mean of 4.05 indicated that the respondents had positive views of science how science makes the world a better place to live in, as a basis of technological advances and the plausible explanation of everything in nature.

Teacher educators' views on Science and Culture

A detailed description of teacher educators' views on each individual item of *Science and Culture* scale is displayed in Table 4 below. It is shown in Table 4 that respondents rated with high agreement toward the statements of items 11, 14, and 18. The mean scores for these three items indicated agreement among teacher educators on how science is viewed in their culture.

Furthermore, the respondents rated in between ‘disagreement’ and ‘undecided’ or ‘agreed’ for six items (9, 12, 13, 15, 16 and 17). The respondents were unsure whether science is universal (item 16); however they tend to agree that science is in harmony with their culture (Item 9).

Table 4

Mean scores and Standard Deviation on Science and Culture Scale (Items 9 to 20)

No	Item Responses	Mean	SD
9	It is easy to incorporate science into one’s personal views of nature	3.78	1.20
10	Scientific knowledge once acquired often dominates one’s way of thinking	2.13	1.00
11	My community appears to be turning against science *)	4.44	0.87
12	Science is often seen as a subculture of Western culture	3.53	1.27
13	Every day occurrence in nature has a non-scientific/culture-based explanations	3.69	1.33
14	Many of the nature’s occurrences are mysterious	4.09	1.14
15	When science is practiced in a community, it reflects a community’s values and beliefs	3.44	1.26
16	Science will progress the same way irrespective of the culture of the scientist involved because its universal	3.31	1.23
17	Western beliefs, values and conventions are an implicit aspect of science	3.47	1.27
18	Science can help the progress of non-western people if they would only assimilate science into their way of thinking	4.22	1.07
19	Science can empower people who belong to a traditional culture, as long as those people learn science without taking on the western beliefs that are as part of science	2.00	1.10
20	Science has helped some nations colonize other nations of a different culture.	2.28	1.42
Grand mean		3.36	0.49

Moreover, the mean score for item 20 represented the respondents’ disagreement on the view that science could be learned without taking into consideration western culture. Items 19 and 10 had the lowest mean scores of 2.00 and 2.13, respectively; indicated their disagreement toward the contents of the statements in those two items. The respondents disagreed with the statements that science can empower people who are traditional in their thinking provided they do not take western beliefs as part of science and that scientific knowledge often dominates one’s way of thinking. The grand mean of 3.36 showed that teacher educators somewhat disagreed or were still undecided or agreed that science is part of the western culture.

Teacher educators’ views on Science and Everyday Common Knowledge

On the Science and Everyday Common Knowledge aspects, as shown in Table 5 the respondents rated all statements positively except for items 24 and 25. Item 24 which use a negative wording in its statement had the lowest mean score; it implies that teacher educators regarded evidences through scientific means as always sensible.

Table 5

Mean scores and Standard Deviation on Science and Everyday Common Knowledge

No	Item Responses	Mean	SD
21	Science and everyday occurrences are so different, it is almost like they belong to different worlds	4.22	1.23
22	Scientist/science educators often use scientific ideas to support ideas found in everyday common knowledge	4.19	0.96
23	Scientist/science educators often use ideas from everyday common knowledge to support scientific ideas	4.00	1.16
24	Evidence arrived at through scientific means is not always regarded as sensible to everyday common knowledge	2.70	1.13
25	Scientific explanations and everyday common knowledge of natural phenomena should always be treated as one	3.25	1.27
26	Scientific explanations of natural phenomena are relevant to everyday societal issues	3.97	0.96
Grand mean		3.73	0.61

The first three item statements of this scale reflected the teacher educators' views of science to explain everyday phenomena. The teacher educators also showed agreement for items 26. For most teachers scientific explanations and everyday common knowledge of natural phenomena have connectedness. The grand mean of 3.73 on this aspect reflected teacher educators' agreement of science as an application of everyday knowledge. This was corroborated by their rating on item 24 with the lowest mean, that evidences arrived as scientific are regarded as sensible to everyday common knowledge.

Teacher educators' views on Science and Everyday Common Knowledge

Table 6 shows that teacher educators' views on culture were supportive of science. The mean scores of all the items were rated with agreement except for item 32 that had the lowest.

Table 6

Mean scores and Standard Deviation on Culture (Items 27 to 33)

No	Item Responses	Mean	SD
27	Culture is lifestyle of a people	3.97	0.96
28	Culture is a system of meaning that people create for themselves	4.63	0.49
29	Culture is the totality of people's identity	4.03	0.93
30	The culture of a people is permanent because it is transmitted from one generation to another	4.38	0.70
31	Nurture (environments) rather than nature (heredity) influences cultural change	4.28	0.99
32	Learning another culture 's way of thinking about natural phenomena can empower people by providing them with a new way of thinking	1.88	0.97
33	Cultural assimilation can oppress people by marginalizing or dominating their ideas	3.53	1.40
Grand mean		3.82	0.48

Nevertheless, as item 32 used negative wording in its statement, the lower mean score indicated a higher agreement among the teacher educators' views. The grand mean at 3.82 in this scale

explained that generally the teachers see their culture as their lifestyle, the meaning they create for themselves, their local identity and their ways transmitted from one generation to the other. Most of them also agreed that environment influences cultural change.

Teacher educators' views on Teaching and Learning Science

Table 7
Mean scores and Standard Deviation on Teaching and Learning Science Scale (Items 34 to 41)

No	Item Responses	Mean	SD
34	Teaching of science centre mainly upon students making personal meaning out of a scientific knowledge	2.13	1.10
35	Science concepts taught in school reflect the dominant culture in my immediate community	3.81	1.20
36	School science imposes a foreign set of cultural values on local students	4.09	1.00
37	The science concepts taught in school science have meaningful use beyond passing examinations	4.28	1.00
38	The primary responsibility of a science teacher is to prepare students for postsecondary studies	4.13	1.20
39	The primary responsibility of a science teacher is to empower students to think for themselves , thereby emancipating students from a dependency on experts and other authority.	4.16	1.10
40	If native students master science, they will likely lose something valuable of their own culture	4.10	1.20
41	For many student , learning science is like going into a foreign culture	3.31	1.40
Grand mean		3.71	0.62

As shown in Table 7, the teachers had a relatively high agreement in almost all the statements on the Teaching and Learning of Science aspect except for statement 34. The highest mean at 4.28 reflected that the teacher educators believed that science concepts taught in the school should have meaningful use beyond passing examinations. These scores designated the teacher educators' degree of agreement towards teaching and not just for the sake of passing the examination. The teacher educators generally believed that the teaching and learning of science should be student-centered as gleaned from the informal interviews and focus group discussions. The teacher educators also expressed their belief that the role of the teacher should change to accommodate a focus on the students' needs and believes that students are the real participants in the learning process. Furthermore to them, learning science is not all about learning a foreign culture.

Generally, the Kenyan teacher educators held more or less similar views elicited from the questionnaires based on the five scales namely on *Science, Science and Culture, Culture, Science and Everyday Common Knowledge, and Teaching and Learning Science*. The analysis of the interviews conducted revealed that many of the teacher educators placed high values on

science and on linking the ideas of science with their personal experiences in and out of the classrooms. These teachers expressed that the purpose of teaching science should be valued for understanding the world around them, and in terms of preparing society for the next generation.

The analysis from the FGD and semi-structured interview on the teacher educators' understandings of science teaching and learning were further explained from the various responses. The interviews with teacher educators and Focus Group Discussions come from lengthy interview were conducted to support teacher educators' views. Consider the following scenario on teachers talking about their views of science, culture and of teaching and learning science, particularly on these instances.

.... I mean, science is fairly difficult for most of my students and I think you can link that to the results that are happening in the exams. However they have to pass the subject course. There are many things ...you can link it to for example things around in the environment... natural phenomena... HIV aids that is common in our communities. All of them can be explained in science. That's why I think science is important because it provides the explanation of all the things happening today. It could have happen in the past but we don't have explanation of it until we apply scientific concepts we learned from science. [ITS3.15.08.06]

... I suppose when I do mathematics teaching its so different...although you need mathematical operation many of things around is all about understanding human life, life support systems, ... the environment and us and the universe at large. I think when you teach this concept in science and if relates to something I think students will remember it better. [ITM6.16.08.06]

These comments may support the questionnaire survey results as indicated in Table 3 (Aspect of Science), Table 6 (Culture scale) and Table 7 (Teaching and Learning of Science).

The following are teacher educator's illustration on situations that relates to their views on the connectedness of science to everyday knowledge.

.... Well, there were practices that we use to practice so much, but people were not really aware we were practicing science for example... preservation of milk in my country is all about science. The way our people use some bark of the tress .. They use charcoal from some trees putting it in the side of the container together with the milk. Later they found out that charcoal from the trees bark added flavour, secondly the charcoal was a way of disinfecting the bacteria that spoils the milk. [FGD1.22.08.06]

The data support teacher educators' views on the aspect of Science and Everyday Common Knowledge as expressed in the survey; and presented in Table 5 previously. Moreover, when the

teacher educators were asked how they saw the connectedness of science to culture, and science as part of western culture; they said during focus group discussion that:

... in most instances...some of our farmers have been embracing some new methods of farming they don't mind integrating it in their traditional practices of farming. So you see ... there are some things that are not new in our culture.... we have science long ago... in that case it's just about an improved technology from the west. That is what I wanted to qualify... I think maybe there are adaptations to our traditional situation. I'd like to say there are also special cases, like GMO's in our country now. ...we are still very negative until recently. There are also certain explanations that our people have different understanding of scientific phenomena which are more or less based on cultural traditions rather than from empirical proofs on technology and diseases. So when you take this principle of genetic engineering ... in scientific manner. You talk about practical approach of solving problems. Like modern medicine ... but somehow it could also be explained based on superstitions when they could not be improved or treated scientifically.... [FGD1. 22.08.06]

In that way, they look at science as the products of the west but by tradition we still practice herbal medicine which is from the practices of our tradition and beliefs. Sometimes, it contradicts in our cultural understanding.... Let us give an example like there is a belief... that somebody can wish for a thunder and for lightning to hit you and it happens Do you explain it to be scientific? [FGD2.24.08.06]

I would say... other things cannot be explained all by science... even if science is the explanation of something....the scientific aspects are introduced by the western. For example in terms of medicine we find that most medicines we used in our homes come from the western products. Then it comes to us as a new technology, example like the test tube baby, it comes mainly from western science. But what is actually happening also in our local scientist... there are also men and women who used to practice herbal medicine in the rural areas which are being encouraged....that is practice ... the treatment of various ailments. For example we just mention AIDS, people they have been encouraged to come out of their ideas of how AIDS can be prevented or can be reduced to a certain level... To some large extent, science is actually a sub-culture of the western. [FGD2.25.08.06]

As gleaned from the focus group discussions, the teacher educators believed that everything in science cannot be regarded as western origin, however some could have been an improvement of what had been practiced within their cultural setting. The teacher educators expressed their views that learning science should foster positive attitudes among students using their own traditional applications to support a scientific inquiry.

A review of researches on teachers' views (e.g. Farrow, 1999; Prawat, 1989) supports that what teachers hold about their teaching and learning can influence in their teaching practice. The primary way in which teachers give meanings to these views is through their practices in the classroom (Peterman, 1993; Tobin, 1993). Teachers' views about teaching and learning, for example, come by experiences received resulting in their actions (Levitt, 2001). According to Ambimbola (1983) and Tobin et al. (1994) as cited by Levitt (2001) the knowledge, views and

theories a teacher holds about the nature of science and the teaching and learning of science determines to a great extent what type of science teaching and learning will be given to a child. From the findings of Eisenhart, Shrum, Harding and Cuthbert (1988) these views reinforce what teachers believe to be most directly related to the classroom learning experiences.

To answer Research Question 3, a t-test was done to determine the significance of the mean differences in the teachers' scores on the five aspects. The comparisons were categorized by respondents' gender, subject specialisation and age. The results are summarized in Table 8.

Table 8
Mean Scores, Standard Deviation, and t Values according to Gender, Age and Subject taught

Scale	Science			Science & Culture			Science & Common Knowledge			Culture			Teaching & Learning Science		
	Group	M	SD	t	M	SD	t	M	SD	t	M	SD	t	M	SD
Male (N=26)	4.03	0.42	0.31	3.45	0.50	+3.82**)	3.71	0.60	-0.37	3.76	0.51	+2.58*)	3.72	0.61	-0.28
Female(N=6)	4.08	0.29		2.97	0.18		3.83	0.74		4.10	0.20		3.81	0.74	
Science (N=20)	4.14	0.41	+1.98	3.44	0.43	+1.06	3.67	0.68	-0.76	3.91	0.49	+1.25	3.63	0.66	
Science Mathematics and others (N=12)	3.88	0.32		3.26	0.58		3.83	0.50		3.69	0.47		3.91	0.54	
30-39 (N=4)	4.19	0.24	+1.12	3.22	0.45	-0.64	3.96	0.48	+0.96	3.64	0.34	-1.08	3.94	0.48	+0.84
40-49 N=28)	4.03	0.41		3.38	0.50		3.70	0.63		3.85	0.50		3.70	0.65	

*) $p < 0.05$; **) $p < 0.001$

Table 8 shows that there was no statistically significant difference on all five aspects when the teacher educators' views were compared based on their subject specialisation and age. The t-test results that indicated statistically significant differences were shown on two scales, namely the connectedness of *Science and Culture* and *Culture*, when grouped according to gender. Male respondents possessed higher or more positive views on Science and Culture aspect (3.45) as compared to their female counterparts (2.97). On the other hand, the female teacher educators hold relatively higher perception on *Culture* scale (4.10) than the male teacher educators (3.76). These results showed that female teachers had different sets of views on the connectedness of science and culture with an implication for further research in this area. In this area of study, classroom observations of teachers may be needed to establish the difference as science education literature is rife with references establishing gender issues on science as a field of

study, with males being more comfortable with the tools in science (Rennie & Parker, 1987) and generally expressing a greater familiarity with science.

Conclusion

From the findings of the study, it could be drawn three themes from the views of the teacher educators participating in the study. First, the teacher educators did espouse that there were certain traditional views that still hold on to their culture. Such traditional views vary at difference degrees to the principles that are connected to scientific explanations. The views that teacher educators express came about as a result of their length of teaching experiences relating science to everyday knowledge.

Second, the teacher educators' responses to the interview questions, as well as during the focus group discussions, suggested that their views about culture, science, teaching and learning of science were more positive as a result of seeing their students engaged in learning science; their views have become more positive accompanying their length of teaching practice and the new approaches introduced by recent technological advancement in science. Most of the teacher educators were not against an application of technology from western science. Many of them also mentioned their length of teaching allowed them to learn from experience.

Third, the teachers' views about science and culture were statistically significant different only when the teachers were grouped according to their gender. In effect, it may help in explaining that the differences in their views could be explained from their cultural background. Research has also shown that gender differences may affect teachers' views and practice (Oyler, Jennings, & Lozada, 2001). Several landmark studies assembled a large body of evidence regarding gender differences on the nature of cognitive differences, with a few studies investigating male schools science experience. This is a positive contribution of the findings considering the teachers have varied ethno-cultural backgrounds.

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