Pupils' Cultural Interpretations of Causes of Rainbow in Kenya.

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Abstract

This study investigated the extent to which primary and secondary school pupils believe in cultural interpretations of the causes of the physical phenomenon of rainbow and the influence of education level, ethnic communities and gender on cultural beliefs. Cross-sectional survey research design was used. The target population was Standard Seven, Form one and Form Three pupils in ten districts selected from Nyanza, Rift Valley, Central, Eastern and Coast Provinces in Kenya. A total of 2837 secondary and 625 primary school pupils participated. The pupils were drawn from 15 primary and 31 secondary schools. A questionnaire was used to gather information from pupils. . Hypotheses were tested using the chi square (χ^2) statistic at $\alpha = 0.05$ level of significance. Some of the results obtained give statistically significant relationship between pupils' beliefs in cultural interpretations of causes of the scientific phenomenon of rainbow and the communities where they come from. There appears to be no significant relationship between pupils' beliefs in cultural interpretations of the scientific phenomenon of rainbow and level of education in some of the communities. There was also a statistically significant relationship between pupils' beliefs in cultural interpretations of causes of rainbow and gender, more girls than boys believed in the cultural interpretations. The findings from this study inform curriculum developers of some of the cultural beliefs that are likely to influence the learning of science. It is recommended that teachers discuss cultural interpretations of scientific concepts before introducing them in their lessons.

Keywords: *Science, culture, beliefs. rainbow, education level, gender.*

1. Introduction

Science educators are now aware of the need to relate science more closely to the learners' cultural environment in order to minimize the possible conflicts that might arise from their view of the world and that of science (Biescheuvel,1972;Urevbu,1984;Odhiambo,1972; Scriber and Cole,1973; Champagne et.al,1983;Black,1984;Ogunniyi,1979,1984,1985,1986a). Ogawa (1986) suggested that, the individual in a traditional culture should be made to see the merits and demerits of science, the similarities and the differences between his worlds view vis-a-avis science such that he can use the knowledge gained to make wise decisions in his daily life. Ausubel, Novak and Hensian (1978) have argued that the construction of new knowledge in science is strongly influenced by prior knowledge that is conceptions gained prior to the new learning. Knowledge construction takes place in a cultural context created by, for example, social and economic class, religion, geographical location, ethnicity and language.

In additions to race and language, other significant factors influence the construction of meaning and therefore are part of cultural identity. These include economic and education levels, occupation, geographic location, gender religion and philosophy (Geertz, 1973).

In cultural anthropology, teaching science is viewed as cultural transmission (Spindler, 1987) and learning science as culture acquisition (Wolcott, 1991), where culture means "an ordered system of meaning and symbols, in terms of which social interaction takes place "(Geertz, 1973 p.5). In past

studies, different attributes of culture have been selected to focus on a particular interest in multicultural or cross-cultural science education (Baker&Taylor, 1995; Barba, 1993). For instance, Maddock(1981,p.20) listed "beliefs, attitudes, technologies, languages, leadership authority structures",Ogawa(1986) addressed culture's view of humans and nature and it's view of thinking;Aikenhead(1996) conceptualized culture according to the norms, values, beliefs, expectations and conventional actions of a group. In our study we conceptualized culture to subsume beliefs, expectations and conventional actions of a group. The phenomenon of heat is subsumed under beliefs. This definition is adopted because in Kenya there are various ethnic groups with different beliefs about 'heat', expected behaviour of a person who is angry and the causal relationship between anger and rise in temperature. Furnham (1992) identified several powerful subgroups that influence the learning of science including the family, peers, the school, the mass media and the physical, social and economic environment.

There is widespread acceptance in the international science education research community that students at all levels of schooling all over the world have a diversity of ideas prior to formal learning (Driver, 1989; Zietsman& Naidoo, 1979).According to Pfundt and Duit (1994) the conceptions about physical phenomena are formed early in life as children try to make sense of the physical world. The persistence of these conceptions have been observed even after the formal study of science (Champagne, Klopper &Anderson, 1980; Caramazza, McCloskey &Green, 1981; Clement, 1982; Osborne&Wittrock, 1983, 1985; Halloun&Hestenes, 1985). The highly robust nature of these preconceptions appears to indicate that they are deeply rooted in students' cognitive structures and makes plausible the idea that they are based upon "alternative frameworks"(Lynch,1995).

2. Purpose and objectives of the study

The purpose of the study was to investigate the extent to which primary and secondary school pupils believe in cultural interpretations of causes of rainbow and the influence of education level, ethnic community and gender on such beliefs. The study was guided by the following objectives:

(i) To find out if primary and secondary school pupils believe in cultural interpretations of causes of rainbow.
(ii) To investigate the relationship between pupils' beliefs in cultural interpretations of causes of rainbow and level of education.
(iii) To investigate the relationship between pupils' beliefs in cultural interpretations of causes of rainbow and gender.
(iv) To compare pupils' beliefs in the cultural interpretations of causes of rainbow from various ethnic communities.

3. Hypotheses

The following hypotheses were tested:

Ho1: There is no statistically significant relationship between pupils' beliefs in cultural interpretations of causes of rainbow and level of education.
Ho2: There is no statistically significant relationship between pupils' beliefs in cultural interpretations of causes of rainbow and gender.
Ho3: There is no statistically significant relationship between pupils' beliefs in cultural interpretations of causes of rainbow and ethnic communities.

4. Methodology

The cross-sectional survey research design was used in this study to gather pupils' beliefs in cultural interpretations of causes of rainbow. .The population in this study included standard seven primary schools pupils, Form One and Form Three pupils in the ten districts that participated in the study.

The accessible population comprised pupils in the 15 primary and 31 secondary schools from which the sample was drawn.

Five provinces were selected randomly for investigation. These are, Nyanza, Rift Valley, Central, Eastern and Coast, in Kenya. The districts were selected purposively. This was to ensure that the majority of the pupils from each district represented a specific ethnic community. Purposive sampling was also used in selecting schools. The aim was to sample schools from rural settings where beliefs in cultural interpretations of scientific phenomena are common. All the secondary schools sampled were provincial boarding, single sex. The aim was to have approximately equal numbers of boys and girls in the sample.

The primary schools were mixed day, apart from two girls' boarding. Only one form one and one from three streams were used in each secondary school. The streams were selected using simple random sampling technique. All the primary schools had only one standard seven class and all the pupils in those classes participated. A total of 2837 secondary and 625 primary school pupils participated in the study.

The questionnaire used contained 6 items which gave suggestions concerning cultural interpretations of the physical phenomena of heat, lightning, rainbow and evaporation. The pupils were asked to indicate whether or not they agreed with the cultural interpretations by ticking YES or NO in the two boxes which were provided. They were further asked to explain why they agreed or disagreed with suggestions given. Responses to only one of the items are reported in this paper. These are beliefs in cultural interpretations of causes of rainbow. Pupils' beliefs in cultural interpretations of causes of rainbow were investigated using the following question:

5. Question:

Rainbow

Two boys Onyango and Bosire were asked to suggest the cause of rainbow. Onyango said: "rainbow is observed when a hyena has given birth in the bush." Bosire said: Rainbow takes place to prevent rain from falling. Do you agree with any of these explanations?

YES ☐ NO ☐

Explain your answer:-

_____

Sample Responses for Rainbow

(a) Scientific Responses

(i) It is caused by sunlight that passes through raindrops and split the white ray into seven colours

(b) Partially Scientific Responses

(i) Rainbow is caused by splitting of sun rays.
(ii) Rainbow is caused by the dispersion of light.
(iii) Sun's rays pass through rain droplets.

(c) Cultural Responses

(i) When the rainbow appears the rain stops to rain.
(ii) God said he will never punish his people with rain again.
(iii) Rainbow doesn't prevent rain from falling because it found when there is small rain.
(iv) When rainbow is seen it is likely to rain.

(d) Non-Scientific Responses

(i) Rainbow is natural the given explanations are wrong.
(ii) Rainbow can never form when a hyena has given birth in the bush, it is just a myth.

Relationship between Pupils' Beliefs in Cultural Interpretations of causes of Rainbow and Level of Education.

The numbers and percentages of pupils who responded to question by saying yes or no are given in Table 1.

Table 1: Numbers and percentages of pupils who agreed or disagreed with cultural interpretations of causes of rainbow.

District	Education Level Total	Type of Response				
		YES		NO		TOTAL
		No	%	No	%	
Embu	Std 7	37	42.05	51	57.95	88
	F1	30	18.40	133	81.60	163
	F3	45	24.59	138	75.41	183
	Total					
Meru South	Std 7	41	58.57	29	41.43	70
	F1	43	24.57	132	75.43	175
	F3	53	33.33	106	66.67	159
	Total					
Kisii	Std 7	50	55.55	40	44.45	90
	F1	95	50.80	92	49.20	187
	F3	78	56.93	59	43.07	137
	Total					
Rachuonyo	Std 7	57	74.03	20	25.97	77
	F1	79	51.97	73	48.03	152
	F3	63	37.06	107	62.94	170
	Total					
Kilifi	Std 7	19	43/18	25	56.82	44
	F1	22	27.85	57	72.15	79
	F3	13	18.57	57	81.43	70
	Total					
Kwale	Std 7	26	50.98	25	49.02	51
	F1	17	23.29	56	76.71	73
	F3	17	26.56	47	73.44	64
	Total					
Nandi	Std 7	20	46.51	23	53.49	43
	F1	46	36.51	80	63.49	126
	F3	60	42.86	80	57.14	140
	Total					
Bomet	Std 7	43	51.81	40	48.19	83
	F1	88	51.76	82	48.24	170
	F3	79	44.38	99	55.62	178
	Total					
Nyeri	Std 7	4	25.00	12	75.00	16
	F1	8	8.99	81	91.01	89
	F3	9	10.84	74	89.16	83
	Total					
Kuria	F1	11	44.00	14	56.00	25
	F3	29	80.56	7	19.44	31

It can be noted from Table 1 that quite a number of pupils from the 10 districts believe in cultural interpretations of causes of rainbow. For example the percentage of Standard 7 pupils who believe in

cultural interpretations is at least 40 in all the districts except Nyeri, and that of Form 3 pupils is at least 30 in Meru South, Kisii, Rachuonyo, Nandi, Bomet and Kuria. This implies that education reduces beliefs in cultural interpretations but does not eliminate such beliefs. The statistical significance of the relationship between pupils' beliefs in cultural interpretations of causes of rainbow and level of education was investigated by chi square statistic and the results are given in Table 2.

Table 2: Relationship between education level and pupils' beliefs in cultural interpretations of causes of rainbow, tested by chi-square statistics

District	χ^2 Value	Df	Asymp Sig (2-sided)
Embu	16.93	2	0.000
Meru South	25.83	2	0.000
Kisii	1.33	2	0.515
Rachuonyo	29.40	2	0.000
Kilifi	8.12	2	0.017
Kwale	11.88	2	0.003
Nandi	11.34	2	0.003
Bomet	2.29	2	0.319
Nyeri	3.52	2	0.172
Kuria	8.73	1	0.004

It can be noted from Table 2 that in three districts namely Kisii, Bomet and Nyeri the relationship between level of education and pupils' beliefs in cultural interpretations of causes of rainbow is not statistically significant. This implies that education does not reduce pupils' beliefs significantly.

Relationship between Pupils' Beliefs in Cultural Interpretations of Causes of Rainbow and Gender

Numbers and percentages of boys and girls who responded by agreeing or disagreeing with the cultural interpretations of causes of rainbow are given in Table 3.

Table 3: Numbers and percentages of boys and girls who responded by agreeing or disagreeing with the cultural interpretations of causes of rainbow

Gender	Responses				TOTAL	
	YES		NO			
	No	%	No	%	No	%
Male	553	34.80	1036	65.20	1589	100.00
Female	664	44.12	841	55.88	1505	100.00
TOTAL	**1217**	**39.33**	**1877**	**60.67**	**3094**	**100.00**

It can be noted from Table 3 that the percentage of girls that believed in the cultural interpretations of causes of rainbow is higher than that of the boys. This implies that boys are more informed about the scientific meaning of the cause of rainbow that is taught in physics subject. In Kenya, more boys choose to study physics in form three in secondary schools as compared to girls. This negative attitude towards physics by girls could probably be one of the reasons why girls do not try to inquire about the physical interpretations of the cause of rainbow. The statistical significance of the relationship between pupils' beliefs in the cultural interpretations of causes of rainbow and gender was checked by chi square statistics (χ^2). The relationship was found to be significant at $\alpha = 0.05$ level.

(χ^2) calculated = 28.12, (χ^2) cited at 1df= 3.841

Relationship between Pupils' Beliefs in Cultural Interpretations of Causes of Rainbow and the Ethnic Communities

Numbers and percentages of pupils from all the districts who responded by agreeing or disagreeing with the cultural interpretations of causes of rainbow are given in Table 4.

Table 4: Numbers and percentages of pupils from the ten districts who responded by agreeing or disagreeing with cultural interpretations of causes rainbow.

District	Responses				Total
	YES		NO		
	No.	%	No	%	
Embu	112	25.81	322	74.19	434
Meru South	137	33.91	267	66.09	404
Kisii	223	53.86	191	46.14	414
Rachuonyo	199	49.87	200	50.13	399
Kilifi	54	27.98	139	72.02	192
Kwale	60	31.91	128	68.09	188
Nyeri	21	11.17	167	88.83	188
Kuria	40	65.57	21	34.43	61
Nandi	126	40.78	183	59.22	309
Bomet	210	48.72	221	51.28	431
TOTAL	**1182**	**39.13**	**1839**	**60.87**	**3021**

Results in Table 4 indicate a wide range of 54.4 between the percentages of pupils who believed in cultural interpretations of causes of rainbow in the ten districts. The percentage of pupils who believed in the cultural interpretations was at least 40 in five out of the ten districts. The low percentages in Nyeri (11.17) and Embu (25.81) imply that such beliefs are not common amongst the Kikuyu and Embu ethnic communities respectively, who live in those districts And the high percentages in Kuria, Kisii, Rachuonyo and Bomet (65.57, 53.86, 49.87 and 48.72 respectively) imply that the majority of members of those communities hold the beliefs. The relationship between pupils' beliefs in the cultural interpretation of causes of rainbow and ethnic communities was found to be significant at $\alpha = 0.05$ (χ^2 critical = 16.919, χ^2calculated = 204.854 at 9df).

6. Discussion

Lewis (2003) argued that students rely on intuitive conceptions to explain events not specifically studied in class. Intuitive conceptions refer to ideas developed as the result of interacting with the natural world. He gave an example of pupils who explained that wool has the ability of being able to warm things up so that a cold object wrapped in wool would spontaneously become warmer. In our study, we realized that some of the pupils were using intuitive conceptions to justify why they believed in cultural interpretations of causes of rainbow. For example, some of them said that they have seen rainfall after the appearance rainbow.

Anamuah-Mensah (1998) explored the extent of native science beliefs among students in secondary schools and tertiary institutions. The study revealed that native science beliefs seem to be held firmly by quite a substantial proportion of students. Results from our study supported Anamuah-Mensah's findings. For example, in three out of the ten ethnic communities that were studied there was no significant relationship between pupils beliefs in cultural interpretations of causes rainbow and level of education. This implies that education does not change pupils' beliefs in cultural interpretations. In six out of the ten ethnic communities the percentages of form three pupils that believed in cultural interpretations were above 40 This implies that education reduces beliefs in cultural interpretations but does not eradicate them.

Ogunniyi (1984) observed that gender, tribe or level of education of the people does not have any significant influence on their world view. This is in agreement with our results with regard to the level of education, but not tribe and gender. This is because in some of the ethnic communities we studied, there was a significant relationship between pupils' beliefs in cultural interpretations of causes of rainbow while in the other communities there was no significant relationship. Results from our study also gave significant relationship between beliefs in cultural interpretations and ethnicity and, with gender. Ogunniyi also suggested that the scientific and African world views are not necessarily mutually exclusive of each other, for example, it is possible to hold a scientific as well as a traditional view of the world, perhaps in the same way as certain scientists in the West hold the scientific and the Christian world views. This suggestion agrees with our findings. In our study we noted that some pupils held both scientific meanings of causes of rainbow and the cultural interpretations, for example, some of the pupils said that rainbow is caused by dispersion of white light, but they also said that, it is a sign of rain.

7.Conclusions

(i) The first objective of the study was to find out if primary and secondary school pupils
(ii) believe in cultural interpretations of causes of rainbow. Empirical data have shown that pupils believe in the cultural interpretations of causes of rainbow.
(iii) Objective two was to investigate the relationship between pupils' beliefs in cultural interpretations of causes of rainbow and level of education. Empirical data have shown that there is a relationship between pupils' beliefs in cultural interpretations of causes of rainbow and level of education in some communities but not in others. But even in those communities where there was a relationship between the two variables, the percentages of form three pupils who believed in the cultural interpretations were over fifty in three of the communities (Kisii, Nandi and Kuria). This implies that education reduces pupils' beliefs in cultural interpretations but does not eradicate such beliefs.
(iv) The third objective was to investigate the relationship between pupils' beliefs in cultural interpretations of causes of rainbow and gender. The results have shown a significant relationship between pupils' beliefs in cultural interpretations of causes of rainbow and gender. More girls than boys believe in the cultural interpretations of causes of rainbow
(v) The fourth objective was to compare pupils' beliefs in cultural interpretations of causes of rainbow from various ethnic communities. The results obtained indicate that some of the cultural beliefs are common among various ethnic communities whereas others are confined within specific communities.

8. Recommendations

(i) Cultural beliefs in interpretations of scientific phenomena should be considered when science curricula are being developed. Teachers should be made aware of such beliefs so that they may use them as advance organizers before introducing the topics whose conceptualizations are likely to be affected by the cultural interpretations.
(ii) There should be a two-pronged attack on reducing the influence of cultural beliefs in science learning. First, the pupils should be made aware of such beliefs and their limitations. Second, adult literacy curricular should incorporate cultural beliefs of scientific phenomena. This will make the public aware of the limitations of such beliefs.
(iii) The significant relationship between the level of education and pupils' beliefs in cultural interpretations of causes of rainbow in some of the communities implies that such beliefs could be reduced further if teachers emphasize their limitations during science lessons.
(iv) The fact that there is a relationship between pupils' beliefs in the cultural interpretations of causes of rainbow and gender implies that the topic is not receiving equal attention in girls'

school' as compared to the' boys' schools. Teachers should therefore provide equal learning opportunities to boys and girls when teaching all science topics.

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