

Cultural Influence on Pupils' Understanding of Conception, Birth of Twins and Sex Determination 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 biological concepts of conception, birth of twins and sex determination and the influence of education level and gender. Cross-sectional survey research design was used. The target population was Standard Seven (7th grade in the primary school cycle), Form one and Form Three (1st and 3rd grades in the secondary school cycle) pupils in 10 districts in Kenya. A total of 3452 pupils (1875 girls and 1577 boys) participated. The pupils were drawn from 15 primary and 31 secondary schools. A questionnaire was used to gather information from the pupils. The findings indicate that pupils believe in the cultural interpretations of biological phenomena investigated. The findings further indicate that there is a relationship between the pupils' believe in cultural interpretations and the academic grade level and gender. The findings from this study, therefore, inform curriculum developers that cultural believes are likely to militate against the pupils' learning of science. It is recommended that teachers discuss cultural interpretations of scientific concepts before introducing them in their lessons.

Keywords: science, culture, beliefs, conception, twins, sex determination

1. Introduction

The world over, the premium placed on science education is high. It is seen as an important instrument that should facilitate sustainable development, poverty reduction and improve the quality of life as a whole. High-quality science education is required not only for sustaining a lively scientific community that is able to address global problems like global warming and pandemics, but also to bring about and maintain a high level of scientific literacy in the general population (van Eijck & Roth, 2007). UNESCO world conference on science in Budapest, Hungary declared that science should be at the service of humanity as a whole and contribute to providing everyone with a deeper understanding of nature and society, a better quality of life and a sustainable and healthy environment for present and future generations (UNESCO, 1999). To achieve this, there needs to be effective teaching and learning of science at all levels, more importantly at the primary and secondary school levels.

There are a number of factors that militate against effective teaching and learning of science. For a long time poor performance or under achievement in science education in Africa has been attributed to inappropriate teaching strategies, unqualified science teachers, lack of appropriate teaching – learning resources and the abstractness of science. Growing evidence from empirical studies now strongly suggests that culture is, indeed, one of these factors (Shumba, 1995; Anmuah-Mensah, 1998, Okere & Keraro, 2002). Cobern and Aikenhead (1998) have argued that learning is about making meaning within a cultural milieu. This perspective has received minimal attention in the context of teaching and learning of science in Africa.

Culture is the label anthropologists give to the structured customs and underlying worldview assumptions that govern people's lives (Kraft, 1998). Culture can also be interpreted as a people's way of life, their design for living, their way of coping with their biological, physical and social environment. The attributes that define culture include language, social structures, skills, customs, norms, attitudes, values, beliefs, expectations,

cognition, conventional artifacts, technological know-how and worldview (Cobern & Aikenhead, 1998). A worldview shapes how people perceive, understand and interpret natural phenomena and all other events in their environment. According to Ogunniyi (1989) traditional African culture relates to the organized body of knowledge, beliefs, values, customs, conventions, routines, and a way of life essentially African in origin, development and orientation, and which are usually passed by word of mouth or example from one generation to another. Cobern (1993) includes gender as an important cultural element that influences the learning of science. Indeed, in many African traditional communities, boys and girls are from time to time separately taught about their respective gender roles. The emphasis in each case is on what directly concerns them in their future lives as men and women, husbands and wives, fathers and mothers and what society expects from them. Girls in such cases may receive lessons on motherhood, conception, child bearing and child care, and nutrition. Boys on the other hand receive instruction on their role as leaders in families, technologists, and problem solvers in society and any other roles that are perceived to be exclusively within the male domain. This certainly is an enhancement of gender stereotyping which would influence the learning of formal science. This would, therefore, suggest that there are likely to be gender variations in the learners' prior conceptions of some of the natural/scientific phenomena and thus the learning of formal science in school. In the context of this paper, culture refers to the established way of life or socially transmitted results of human experience through which a group of people carry their way of life. It includes language, customs, morals, tools, beliefs and belief systems, institutions, knowledge and worldview.

2. Culture, Worldview and Constructivist Learning

Constructivism as a learning theory has its foundations in Jean Piaget's theory of 'genetic epistemology'. It is based on observation and a scientific study about how people learn. Within the constructivist learning model, learning is an active process in which learners have to actively construct meanings from their own experiences to build unique representations of content or change their prior conceptions (Good & Brophy, 1995; Atwater, 1994; Driver, 1989; Driver & Bell, 1986; Piaget, 1964). Lewis and Linn (2003) pointed out that students' rely on intuitive conceptions to explain events not specifically studied in class. Intuitive conceptions refer to ideas developed as a result of interacting with the natural world. Constructivism views learners as cognitively active participants in the process of constructing meanings from their experiences. Meaningful learning occurs by interpreting a message and not by receiving a transmission. Critical, therefore, in the learning of science within the constructivist learning model is a learner's prior conceptions. Construction thus would involve interpretations influenced by prior knowledge, and this suggests a conceptualization of scientific knowledge in which it is reasonable to expect culture specific understanding of science concepts (Cobern, 1996). Driver's (1989) observation that cognitive ethnographies undertaken in classroom settings indicate that learners' prior ideas are an important factor in their understanding of formal science further reinforces this argument.

Atwater (1994) points out that culture is an important aspect of a child's development. It is a strong designer of human nature, experiences and their interpretations. It is also acknowledged that a child's conceptual development is a function of several factors including the social-cultural background, mental maturity and environment (Ogunniyi, 1985). By the time African children are being introduced to formal science in school, they have already been exposed to their cultural worldview and have a repertoire of cultural beliefs, myths and explanations for physical and biological phenomena. They would also have participated in a wide range of cultural practices and consequently developed conceptual schemes that come to bear on the learning of science. Their worldview, therefore, shapes how they perceive, understand and interpret phenomena because their culture of origin conceptions come into play.

Formal science has been presented in the literature as originating from the West hence reflects the Western worldview and mode of thinking (Pauka, Treagust & Waldrip, 2005; Aikenhead & Jegede, 1999; Cobern & Aikenhead, 1998; Cobern, 1996; Ogunniyi, 1988; Odhiambo, 1972). This thus makes school science alien to students from African and other non-Western cultures. In Moddock's (1981) words, school science is like a foreign culture to them. Morris (1983) and Cobern (1993) argue that learning does not take place in a vacuum, it occurs against the background of a view of the world and society. Students, therefore, come into a classroom with their own knowledge base on science concepts based on their socio-cultural interactions and experiences. It has been pointed out that African communities, and more particularly those in rural areas often hold deep rooted traditional beliefs about certain things which in some cases do not conform to conventional scientific explanations (Gray, 1998). Therefore, for African children to learn formal science is to acquire a new culture, a new worldview. Aikenhead and Jegede (1999) refer to this as border crossing, crossing the border from African culture to the culture of science.

The study reported in this paper investigated the extent to which students believe in cultural interpretations of the biological concepts of conception, the birth of twins, and sex determination and evaluated the influence of these interpretations on the learning of science in schools.

3. Purpose and Objectives of the Study

The study was designed to investigate the extent to which primary and secondary school students believe in cultural interpretations of selected biological concepts and how such interpretations influence their conceptualization of these concepts. Its specific objectives were:

- To find out if primary and secondary school pupils believe in cultural interpretations of selected biological phenomena and how such interpretations influence conceptualization of the phenomena.
- To investigate the relationship between pupils' believe in cultural interpretations of selected biological phenomena and level of education.
- To investigate the relationship between pupils believe in cultural interpretations of phenomena and gender.

4. Research Questions

The following research questions were used to guide the study.

- Do primary and secondary school pupils believe in the cultural interpretations of selected biological phenomena?
- Is there a relationship between pupils' beliefs in cultural interpretations of selected biological phenomena and academic level of education?
- Is there a relationship between pupils' beliefs in cultural interpretations of selected biological phenomena and gender?

5. Methodology

The simultaneous cross-sectional survey research design was used in this study. The design was found to be suitable for obtaining pupils' cultural interpretations of the selected biological phenomena at one point in time. Schools were used as sampling units and a total of 3452 pupils (1875 girls and 1577 boys) were sampled. This comprised 625 and 2827 pupils from primary and secondary schools respectively. The National Council for Science and Technology (NCST) in the Ministry of Higher Education that is mandated to authorize academic research in Kenya authorized and financed the researchers to conduct this study in public schools.

The primary school cycle in Kenya takes 8 years. It starts from standard 1 (grade 1) to standard 8 (grade 8) and thus takes pupils 8 years to graduate and join the secondary school cycle. The secondary school cycle takes 4 years with form 1 being the first grade and form 4 the final grade. The study sample was selected from standard seven pupils (seventh grade in the primary school cycle) and forms one and three pupils (first and third grade in the secondary school cycle). The age of pupils joining primary 1 is 6 years. Therefore, the average ages of pupils included in the study sample are 12, 14, and 16 for standard 7, form 1, and form 3 respectively. The sample was purposively drawn from 15 rural primary and 31 rural secondary schools from ten districts in five regions (formerly provinces) in Kenya. The districts were purposively selected to ensure that the pupils from each district represented one cultural/ethnic community. Table 1 shows the distribution of the study sample.

Table 1. Distribution of number of schools and pupils per region and district

Region	District	No and school type			No and gender of pupils						Total
		Boys Sec	Girls Sec	Primary	Primary	Form 1		Form 3			
					Boys	Girls	Boys	Girls	Boys	Girls	
Nyanza	Rachuonyo	2	2	2}							
	Kisii	2	2	2}	88	84	199	280	188	268	1107
	Kuria	-	1	- }							

Eastern	Meru South	2	2	2}	46	113	203	166	182	171	881
	Embu East	2	2	2}							
Coast	Kilifi	1	1	1}	27	75	72	87	58	81	400
	Kwale	1	1	1}							
Central	Nyeri	1	1	1	-	16	43	40	46	38	183
Rift	Nandi	2	2	2}	80	96	168	180	177	180	881
Valley	Bomet	2	2	2}							
	TOTAL										3452

6. Instrumentation

A questionnaire having three items was administered by the researchers with assistance from primary science and biology teachers in the respective schools. The items gave suggestions concerning cultural interpretations of selected biology concepts (conception, **birth of twins** & sex determination) drawn from the topic reproduction. The concepts selected are covered in both primary science and secondary school biology albeit to varying depths with the exception of sex determination which is introduced in form 3 in secondary school biology. However, these concepts attract a lot of attention in traditional cultural communities and thus have a number of cultural interpretations. The following are the survey items used in this study:

Prenancy

1. Two form three girls were having a discussion on the most likely period of conception (becoming pregnant). One girl suggested that it is:

(i) If they have sexual intercourse when they are having periods.

The other girl stated that it is:

(ii) Any time they have sexual intercourse.

Do you agree with any of the explanations?

YES [] NO []

Explain your answer

Birth of Twins

2. Janet gave birth to twins. The elders in her village explained that this happened because of one of the following reasons:

i. Janet must have eaten 'twin' bananas (double) or eggs with twin (double) yolk when she was pregnant.

ii. It was a curse.

Do you agree with any of these explanations?

YES [] NO []

Explain your answer.

Birth of Daughters

3. In our communities, it is common to find parents who have got daughters ONLY. The explanation given is that the mother is not capable of giving birth to a son.

Do you agree with this explanation?

YES [] NO []

Explain your answer.

6.1 Data Analysis

Content analysis was applied on the qualitative data generated. The data was analyzed to establish the extent to which the pupils believed in the cultural interpretations. The analysis also evaluated whether the beliefs vary with grade/academic level and gender.

6.2 Results

6.2.1 Pupils' Cultural Explanations of the Period of Conception

The item *pregnancy* was used to investigate the pupils' believe in cultural interpretations of the most likely period of conception and their understanding of the menstrual cycle. A total of 2,777 pupils responded to this item and 1,592 of them (57.33%) agreed with one of the cultural explanations given or suggested a more 'plausible' one. The remaining 1,185 (46.67%) pupils disagreed and some of them gave either a scientifically acceptable explanation or none at all in some cases. The pupils' responses were categorized as either being cultural or scientific explanations. The following are sample responses.

Scientific explanations

- (i) Pregnancy takes place during ovulation.
- (ii) When experiencing periods the ova will have died hence there will be no fertilization.

Cultural explanations

- (i) Having sex during periods.
- (ii) Having sex any time.
- (iii) When you have sex with an adult.
- (iv) It is during periods the egg is released.
- (v) During periods the ovum is ready for fertilization.

The pupils' responses were further analysed on the basis of level of education and gender. The results are presented in tables 2 and 3.

Table 2. Numbers and percentages of pupils agreeing or disagreeing with suggested cultural interpretations of the likely period of conception

Education Level	Total no. of respondents	Total agreed		Total disagreed	
		No	%	No	%
Standard 7	415	295	71.08	120	28.92
Form 1	1160	698	60.17	462	39.83
Form 3	1202	599	49.83	603	50.17
Overall	2777	1592	57.33	1185	42.67

The result in table 2 indicates that 71.08% of the pupils in standard 7 believed in the cultural interpretations of the likely period of conception followed by those in form 1 (60.17%) and form three (49.83%). The trend that emerges shows a clear relationship between the pupils' level of education and their conceptualization of the period of conception. A majority of the pupils in standard 7 believe in cultural interpretations and this progressively decrease as they move through to the upper grades in the school system but are never eliminated. This would suggest that the learning experiences provided in school science enable learners to progressively erode the cultural interpretations though they are never completely eliminated.

Table 3. Numbers and percentages of pupils agreeing or disagreeing with suggested cultural explanations of the likely period of conception by education level and gender

Education Level	No	Agreed		Disagreed	
		No	%	No	%
Boys					
Standard 7	199	142	71.36	57	28.64
Form 1	583	392	67.24	191	32.76
Form 3	584	401	68.66	183	31.34
Sub total	1366	935	68.45	431	31.55
Girls					
Standard 7	216	153	70.83	63	29.17
Form 1	577	306	53.04	271	46.97
Form 3	618	198	32.04	420	67.96
Sub total	1411	657	46.56	754	53.44
Overall	2777	1592	57.33	1185	42.67

Table 3 shows that the boys and girls in standard 7 equally believed in cultural explanations of the likely period of conception (71.36% and 70.83% respectively). This pattern changes in forms 1 and 3 where the percentage of girls holding cultural explanations drops drastically compared to that of boys. The percentage of the girls who agreed with the cultural explanations is 53.04 % and 32.04% for those in forms 1 and 3 respectively. As the girls mature, they progressively discard the cultural explanations, something that is not noticeable among boys. It would appear that a majority of the older girls who have reached the stage of puberty have sought explanations for the physiological process they are going through from those who have had the experience and, therefore, have a better understanding of the menstrual cycle. The percentage of boys in form 1 and 3 holding cultural explanations is at par (67.24% and 68.66% respectively).

6.2.2 Pupils' Cultural Interpretations of the Birth of Twins

The item *birth of twins* was used to investigate pupils' believe in cultural interpretations of the birth of twins. A total of 3252 pupils gave responses to this item and 422 of them (12.98%) agreed with one of the suggested cultural explanations or gave a more 'plausible, one. The remaining 2830 pupils (87.02%) disagreed. Some of those who disagreed gave scientifically acceptable explanations while the rest did not give any alternative interpretations. The following are sample responses.

Scientific explanations

- (i) Birth of twins is caused when two ova are fertilized at same time.
- (ii) When fertilized ovum splits into two.

Cultural explanations

- (i) When sperm moves at high speed and hit the egg and break it into two.
- (ii) Sex between male and female.
- (iii) When two sperms fertilize together.
- (iv) Twins are a blessing from God.
- (v) When you eat double (*twin*) banana.
- (vi) It is believed that a man is very strong.
- (vii) It depends if any of your relatives or your mother gave birth to twins.
- (viii) Caused by God.

The pupils' responses were further analyzed on the basis of level of education and gender. The results are presented in tables 4 and 5.

Table 4. Numbers and percentages of pupils agreeing or disagreeing with suggested cultural explanations of the birth of twins by education level

Education Level	Total no. of respondents	Total agreed		Total disagreed	
		No	%	No	%
Standard 7	588	177	30.10	411	69.90
Form 1	1238	137	11.07	1101	88.93
Form 3	1426	108	7.57	1318	92.43
Overall	3252	422	12.98	2830	87.02

The result shows that on a whole fewer pupils believed in cultural explanations of birth of twins at all the three grade levels. Among the standard 7 pupils 30.10% believed in the cultural explanations compared to 11.07% and 7.57% of those in forms 1 and 3 three respectively. The result also shows a progressive decrease of these cultural explanations from standard 7 to form 3. This is an indication that exposure to formal science in school facilitates learners' 'border crossing from traditional culture to the culture of science'.

Table 5. Numbers and percentages of pupils agreeing or disagreeing with suggested cultural explanations of the birth of twins by education level and gender

Education Level	No of respondents	Agreed		Disagreed	
		No	%	No	%
Boys					
Standard 7	248	65	26.21	183	73.79
Form 1	707	68	9.62	639	90.38
Form 3	725	44	6.07	681	93.93
Sub total	1680	177	10.54	1503	89.46
Girls					
Standard 7	271	47	17.34	224	82.66
Form 1	601	68	11.31	533	88.69
Form 3	700	63	9.00	637	91.00
Sub total	1572	178	11.32	1394	88.68
Overall	3252	354	10.89	2898	89.11

The result in table 5 shows that when the pupils' responses are analyzed by gender the trend given is similar to that of the grade levels where a majority of those holding cultural meanings are in the lower grade with a progressive decline to the higher grades. There also appears to be a gender difference within grade levels. The percentage of standard 7 boys accepting cultural interpretations (26.21%) is much higher than that of girls (17.34%). This trend however reverses in forms 1 and 3 where more girls accept cultural interpretations compared to boys.

6.2.3 Pupils' Cultural Interpretations of Sex Determination

The item *birth of daughters* was used to investigate pupils' believe in cultural interpretations of sex determination. A total of 2252 pupils gave responses to this item and 279 of them (12.39%) agreed with one of the suggested cultural explanations or gave a more 'plausible' one. The remaining 1973 pupils (87.61%) disagreed. Some of those who disagreed gave scientifically acceptable explanations while the rest did not give any alternative interpretations. The following are sample responses.

Scientific explanations

- (i) A mother always produces X chromosomes and father produces X and Y chromosomes. It is possible that the father is only producing X chromosomes which make up a girl.
- (ii) Baby boys are determined by the chromosome Y of the man.

Cultural explanations

- (i) Mother can't give birth to a son.
- (ii) Sperms of man are not strong.
- (iii) It is due to inheritance.
- (i) This is a result of father staying in kitchen most of the time when he was young.
- (ii) This is because the mother had many daughter cells compared to the father.

Table 6. Numbers and percentages of pupils agreeing or disagreeing with suggested cultural interpretations of sex determination by grade level

Education Level	Total no. of respondents	Total agreed		Total disagreed	
		No	%	No	%
Standard 7	348	85	24.43	263	75.57
Form 1	863	99	11.47	764	88.53
Form 3	1041	95	9.13	946	90.87
Overall	2252	279	12.39	1973	87.61

The result shows that only 12.39% of the study sample believed in cultural interpretations of sex determination. There is, however, variation between the grades/education level with the highest percentage being in standard 7 (24.43%) and the lowest (9.13%) in form 3. It is also important to note that though this concept is covered in the topic genetics in secondary school biology in form 3, pupils in standard 7 and form 1 have some 'ideas' about it. These ideas must have been formed through their socio-cultural interactions.

Table 7. Numbers and percentages of pupils agreeing or disagreeing with suggested cultural interpretations of sex determination by grade level and gender

Education Level	No	Agreed		Disagreed	
		No	%	No	%
Boys					
Standard 7	154	47	30.52	107	69.48
Form 1	450	53	11.78	397	88.22
Form 3	434	52	11.98	382	88.02
Sub Total	1038	152	14.64	886	85.36
Girls					
Standard 7	194	38	19.59	156	80.41
Form 1	413	46	11.14	367	88.86
Form 3	607	43	7.08	564	92.92
Sub Total	1214	127	10.46	1087	89.54
Overall	2252	279	12.39	1973	87.61

The result indicates that on a whole there is a gender variation in pupils' believe in cultural explanations of the determination of a child's sex. The percentage of boys accepting cultural explanations (14.65%) is slightly higher than that of girls (12.39%). This is more pronounced among the standard seven pupils where 30.52% of the boys accept cultural explanations compared to 19.59% of the girls. Though the gender variation among the form 1 and 3 pupils is not pronounced, it is important to note that the overall trend is maintained where more boys accept cultural interpretations at all levels.

7. Discussion

The results in this study have revealed that a good fraction of the pupils in both the primary and secondary schools in rural schools in Kenya hold cultural interpretations of the biology concepts that were investigated. They accept what Lewis and Linn (2003) refer to as intuitive conceptions to explain concepts they may have not encountered in formal science lessons. For instance the standard 7 and form 1 pupils had ideas on how the sex of a child is determined, a concept that they have not covered in primary science and form 1 biology lessons. There, indeed, was no major variation in the interpretations given by pupils from the different ethnic communities sampled in this study. There is also a strong indication that these explanations are coming from the pupils' socio-cultural environments. Among concepts investigated, conception attracted the highest percentage of pupils holding cultural interpretations and hence was the least understood by pupils at all levels.

In all cases, there was a progressive decline of the cultural interpretations from the lowest to the highest grade included in this study. Anamuah-Mensah (1998) explored the extent of native science beliefs held by students in secondary and tertiary institutions in Ghana. The study revealed that a substantial proportion firmly held native science beliefs. The study further revealed that formal education gradually eroded these beliefs but did not eliminate them. The results in our study support Anamuah-Mensah's findings. Ogunniyi (1984) conducted a study on the youth in Southern Nigeria to investigate the relative influence of supernatural forces among the Yuroba youth. One of the conclusions made from this study is that the scientific worldview may not be able to completely displace the people's traditional world outlook even after a thorough exposure to formal science. In some cases, pupils hold both cultural and scientific interpretations of a concept without any conflict but their responses depend on the context in which they find themselves.

The results from the current study further reveal that the extent to which cultural interpretations are held by pupils varies with gender. This contradicts one of the conclusions from Ogunniyi's (1984) study which indicates that the gender of the people does not have any significant influence on their traditional worldview. A proportionately higher number of boys held cultural interpretations of conception and sex determination compared to girls at all levels. This variation is more pronounced for the item *pregnancy*. This supports Cobern's (1993) argument that gender is a cultural variable that would influence pupils' learning of formal science. Indeed, from the researchers' cultural backgrounds, some concepts covered in biology are taboo and are never discussed openly and freely between adults and the youth, more especially between the opposite sexes (men and women or boys and girls) and may in such circumstances not be effectively covered even in science lessons. However, these concepts are openly discussed among peers or their seniors of the same sex. This would explain the gender variations observed in this study. All the concepts covered in this study fall in this category.

8. Conclusions

The findings from this study provide evidence that both the primary and secondary school pupils believed in cultural interpretations of biological concepts investigated and this militates against their understanding of these concepts. This would also apply to other biological and physical phenomena. The findings also indicate that there is a relationship between the pupils' believe in cultural interpretations and the level of education. Believe in cultural interpretations gradually declines with increasing exposure to formal science but is never eliminated. There is also a relationship between pupils' believe in cultural interpretations and gender. This is more pronounced at lower levels and also declines with more exposure to formal science.

For effective teaching and learning of science cultural interpretations of scientific or natural phenomena need to be brought to the fore. This would enable science teachers to provide learning experiences that can effectively challenge these interpretations and allow learners to change their prior conceptions. Science teacher education should emphasize the use interactive approaches that require active participation of learners in science lessons. This would enable them to actively construct knowledge for themselves and, therefore, engage in meaningful learning and thus enhance what Aikenhead and Jegede (1999) have referred to as border crossing. This would enhance a smooth border crossing from the African culture to the culture of science. Indeed, for effective teaching and learning of science, the starting point should be the learners' existing knowledge.

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