Influence of Culture and Gender on Secondary School Students' Scientific Creativity in Biology Education in Turkana County, Kenya

Susan A. Aruan[1*] Mark I. O. Okere[2] Samuel Wachanga[3]
Department of Curriculum, Instruction and Educational Management, Egerton University, PO box 536, Njoro, Kenya

Abstract
The purpose of this study was to establish the extent to which biology scientific creativity skills are influenced by the students' culture and gender in Turkana County. A mixed method research design was used. This involved cross sectional survey and ethnographic study. The target population comprised all form three students in sub county schools who were approximately 1000, 10 men and women of 55 years and above in Turkana county. A sample of 320 students (160 girls and 160 boys) from 4 sub county schools and 10 adults (5 men and 5 women) and two homesteads were involved in the study. Selection of participating schools was by stratified random sampling and purposive sampling for the sub county schools. The adults were selected by purposive sampling. Four instruments, namely; Students' Culture Evaluation Questionnaire (SCEQ), Biology Scientific Creativity Test (BSCT), an Interview Schedule (IS) for the adults and Observation Schedule for the homesteads were used to collect data. Validation of the instruments was done by seeking the opinion of experts from the Faculty of Education and Community studies of Egerton University. The test items were pilot tested in one sub county co-educational school in Turkana County. Reliabilities of SCEQ and BSCT were measured using Cronbach coefficient alpha. The hypotheses were tested at α=0.05 significance level. The inferential statistics used were the chi-square and t-test. The reliabilities coefficients of 0.7 for SCEQ and BSCT was realized and accepted. Data from the interview and observation schedules were analyzed quantitatively. The results of this study may provide valuable information to policy makers, curriculum developers and implementers which could be helpful in fostering positive cultural practices that enhance scientific creativity in learners.
Keywords: scientific creativity, culture, gender, influence

Introduction

Education is meant to prepare learners to make sense of how the world works; to think critically and independently; and to lead responsible and productive lives in a culture that is increasingly shaped by science and technology. In Kenya one of the main goals of education is to promote social, economic, technological and industrial skills for national development. Education therefore, should produce citizens with skills, knowledge, expertise and personal qualities that are required to support a growing economy, rapid industrial and technological changes taking place especially in the developed world (Kenya National Examination Council, 2010).

Biology is a practical subject which equips learners with concepts and skills that are useful in solving everyday problems of life. The study of Biology aims at providing learners with the necessary knowledge with which to control or change the environment for the benefit of an individual, family or society. It also prepares learners for studies in applied disciplines like agriculture, medicine, biotechnology, genetic engineering and processing industries especially for beer and milk (Maundu, Sambili, & Muthwii, 1998).

It is claimed that school leavers who can think critically and respond creatively will more likely be able to meet the challenges of the 21st century by contributing positively to the personal, social, technological and economic worlds that they will inhabit as adults (Welle-strand & Tjeldvoll, 2003). It has been noted that there is lack of understanding about basic biology concepts and principles such as evolution (Alters & Nelson, 2002) and ecology (Mason, 1992) and even significant chronic misconceptions about key ideas such as the importance of scientific reasoning.

The concept of creativity is used in various fields of study and the meaning attached to it varies from one field to another. According to Boden (2001), creativity is one's ability to come up with new ideas that are surprising yet intelligible, and also valuable in some way. Therefore novelty and value should be the two conditions or characteristics of scientific creativity . According to these two characteristics, scientific creativity can be identified either with historical creativity (when something, like a new idea, a new theory, a new discovery, is historically new) and/or with personal creativity (when something is new in a personal sense regardless of whether that something is not new to others). Sternberg (1995) also gives the essentials for creativity as intelligence, knowledge, thinking styles, personalities, motivation and environment. Treffinger (2001) and Loehle (1990) argue that many characteristics associated with creativity are not innate but can in fact be taught and nurtured. They further point out that creative behaviour is influenced by motivational as well as situational factors.

Okere (1986) gives indicators of creativity in science education as sensitivity to problems, flexibility in reasoning, recognition of relationships and planning for scientific investigations.

Therefore the notion of creativity in the context of science education should take into account all these ideas. Science educators and teachers should provide an environment that increases the possibilities for creativity to emerge and opportunities for divergent thinking among learners. Creativity is increasingly considered a crucial ability for the future. Creativity is not just becoming increasingly important (Pink, 2005), but it seems that our future is now closely tied to human creativity (Csikszentmihalyi, 1996). Gardner (2010), in his *Five Minds for the Future*, argued for the crucial role of creativity, as one of the five cognitive abilities that leaders of the future should seek to cultivate. However, there is empirical evidence that students do not appreciate the creative thinking required in doing science, and that they do not view science in general as a creative endeavour (Schmidt, 2011).

Further, despite its importance, creativity is not yet fully established as a mainstream topic in psychology and/or education research; neither does it hold a significant position in educational practice (Boden, 2001). This is somehow paradoxical , given that creativity is inextricably tied to the nature of science itself (McCo-mas, 1998), and also the consensus among scientists and science educators that scientific knowledge is indeed the product of creative thinking (Osborne, Collins, Ratcliffe, Millar & Duschl, 2003).

Educational systems worldwide are being reformed to adapt to rapid societal changes, due to global economic restructuring and technological development (Bellofiore, 1999). Students need to be prepared for life in a world about we know very little, except that it will be characterized by substantial and rapid change, and is likely to be more complex and uncertain than today's world (Hodson, 2003). National Advisory Committee on Creative and Cultural Education (1999) pointed out that creativity in education has a part to play in helping students meet the unpredictable demands of the future. Training students in creative skills may contribute significantly to their flexibility, and their ability to handle changes in their working lives.

Culture is the label that anthropologists give to the structured customs and underlying worldview assumptions that govern people's lives (Kraft, 1998). It can also be interpreted as people's way of life, their design for living, and their way of coping with their biological, physical and social environment. The attributes that define culture include language, social structures, skills, customs, norms, values, beliefs, attitudes, expectations, cognitions, conventional artifacts, technological know- how and worldview of a group (Cobern & Aikenhead, 1998). Ausubel, Novak and Hensian (1978), argued that the construction of new knowledge in science is strongly influenced by prior knowledge that is conception gained prior to new learning. Studies on the influence of culture on scientific creativity in physics have shown that the levels of scientific creativity are low among the students. This has been attributed to many factors including inappropriate teaching strategies, lack of appropriate teaching and learning resources. Empirical evidence now strongly suggests that culture is indeed, one of these factors (Shumba, 1995; Anmuah- Mensah, 1998; Okere & Keraro, 2002). This study investigated the influence of Turkana culture on scientific creativity among Kenyan Secondary School Students.

According to Ai (1999) past research has usually concentrated simply on whether there is a relationship between creativity and academic achievement without taking into consideration whether the relationship could be dissimilar for the two groups, male and female. While there are research results pointing in various, and often contradictory directions, the evidence does not clearly support gender differences in creativity based on test results. However to the extent that a case for such gender differences can be made available evidence suggests that women and girls tend to score higher on creativity tests than men and boys.

Kogan (1974), Tegano and Moran (1989) found a tendency for girls to score higher than boys. However, boys scored higher on originality in grade three. Coone (1969) and Warren and Luria (1972) found higher scores for girls in early adolescence on figural creativity. Torrance (1983) found that gender differences in divergent thinking ability have changed over time. In the 1950's and 1960's boys outperformed girls on measures of originality, whereas girls surpassed boys on elaboration and most measures of verbal creativity (Torrance, 1962, 1965). A study conducted in Kenya by Ndeke (2012) found that there was a positive and significant relationship between scientific creativity in biology and gender. The indications were that creativity skills of sensitivity, flexibility and recognition of relationships were gender dependent but planning was not. The largest inconsistency is between scores of tests designed to predict creativity and actual accomplishments. This study investigated the influence of gender on scientific creativity in biology education in Turkana County.

Purpose of the study

This study sought to investigate the influence of students' culture and gender on scientific creativity in Biology Education among Form Three Secondary School Students in Turkana County in Kenya.

Objectives of the study

The following objectives guided the study;

i. To investigate cultural beliefs, practices and values that relate to creativity in Biology Education in Turkana County.

ii. To determine the level of Scientific Creativity in Biology among Form Three Students.
iii. To determine if there is a significant relationship between the learners' culture and scientific creativity in Biology Education.
iv. To investigate if Scientific Creativity Skills in Biology is gender dependent.

Hypotheses of the study

H_o1 There is no statistically significant relationship between culture and scientific creativity in Biology education amongst Form Three students.

H_o2 There is no statistically significant difference in performance in scientific creativity in Biology education among Form Three boys and girls.

Research methodology

Mixed methods research design was used in this study. Mixed methods research design combines quantitative and qualitative approaches in investigating a problem (Onwuegbuzie& Leech, 2004). The design employed cross-sectional survey and ethnographic study. The target population for this study was Form Three Students in Sub County Schools who are approximately 1000 and men and women of 55 years of age and above and Turkana homesteads. The accessible populations from which the sample was drawn from are 4 sub county schools adding upto 320 (160 boys and 160 girls), 10 adults (5men and 5 women) and two homesteads. A list of all sub county schools from the education office formed the sampling frame. Using purposive sampling, 4 co-educational sub county schools were selected which were mainly composed of students from the Turkana tribe. Many schools had more than one Form Three Class and only one class per school was involved in the study. The selection of the class of study was through simple random sampling procedure. On the basis of the class size of 40 students approved by the Ministry of Education, Science and Technology, the sample size was 320 for this study. The adults that were involved in the study were selected using purposive sampling procedure from among Turkana men and women of 55 years and above who formed the sampling frame. A sample of 10 adults participated in this study. Two Turkana homesteads were selected through purposive sampling. In this study four instruments were used to collect data, these included; Students' Culture Evaluation Questionnaire (SCEQ), Biology Scientific Creativity Test (BSCT), Interview Schedule (IS) and Observation Schedule (OS). They were constructed by the researchers and validated by three experts in creativity in science education from Egerton University.

Instrumentation

Students culture evaluation questionnaire (SCEQ)

The SCEQ contained 9 questions, a few which were open ended while the rest required students to give yes or no answers and explaining them briefly. This was used to evaluate cultural values, rules and regulations and practices of the Turkana tribe that either stifles creativity such as strict cultural practices William, et al (1995), (Sternberg & Lubart, 1999) or those that foster creativity in children such as perseverance. The items were scored based on the relevance of the points given by the respondent in which 2 marks were awarded for every relevant answer or response. The reliability coefficient estimated by Cronbachs alpha was 0.7.

Biology scientific creativity test (BSCT)

The Biology Scientific Creativity Test had sections A, B, C & D. All the items in BSCT were open ended with each question testing different aspects of creativity. The test was aimed at assessing Form Three learners' competence in scientific creativity abilities which included; Sensitivity to the problems – The items required students to identify whether the statements were scientifically testable and give an explanation which involved rephrasing the statements. The items in this section were scored in such a way that 1 mark was awarded for stating whether the statement was scientifically testable or not and 2 marks were awarded for correctly rephrased statement. Flexibility in reasoning – The items required students to suggest various methods of solving a given problem or approaches to an investigation. A total of 4 marks were scored for each of the questions in this section. Therefore 1 mark was awarded for each correct response. Recognition of relationships – This skill required students to recognize relationships between observations and scientific knowledge acquired from science lessons. A score of 2 marks was awarded for every correct explanation. Planning for investigation in Biology – This skill required students to plan for an investigation. This involves suggesting the equipment to be used, experimental procedure and method of data analysis. Each question carried 10 marks in this section. A score of 2 marks was awarded for every step correctly explained. The reliability coefficient estimated by Cronbach's alpha was 0.7.

Interview schedule for the adults
The interview schedule contained questions requiring the adults to explain why they adopted the practices discussed in the questionnaire.

Observation schedule
The observation schedule contained a brief explanation of the various aspects that the researcher was making observations on in the natural setting of the participants.

Sample items on each aspect of the psychological definitions of scientific creativity
Item on Sensitivity
The following statement is not testable scientifically.

"Fat people lead better lives than thin ones"

State whether the above statement is correct or incorrect which explains whether it is scientifically testable or not.

Rephrase the statement in such a way that it is scientifically testable.

Stating whether the statement was scientifically testable was scored 1 mark while correctly rephrased statement was scored 2 marks.

Item on recognition of relationships
It has been observed that a dog weighing 15.2kg requires 216KJ while a mouse weighing 50g requires 2736 KJ per day. Explain.

For every correctly recognized and fully explained relationship among concepts the learner scored 2 marks.

Item on flexibility
A rabbit escapes from predators by leaping left and right in a zigzag pattern while a honeybee stings the predators. Suggest four possible reasons why the rabbit runs in that manner rather than sting to escape predation like the honeybee.

Flexibility in reasoning is giving more than one correct response. Maximum score was 4 marks, one for each correct response.

Item on planning
A group of students were investigating the number of Tilapia fish in a shallow pond using the capture recapture method. Describe how the students would go about this.

This item tested planning for investigations whereby the learner was to answer several questions where each consisted of 2 marks and the maximum score was 10 marks.

Results
Difference in performance in Biology Scientific Creativity Test by Gender

To determine if the performances in BSCT by gender were significantly different, raw scores in the test were used to calculate the mean score. The results are as shown in Table 1.

Table 1
Means and standard deviations of the scores obtained by boys and girls in the biology scientific creativity test (BSCT)

Gender	N	Mean	Std. deviation	Std. Error Mean
Boys	160	15.51	4.794	0.536
Girls	160	14.34	7.979	0.892
Total	320	29.85	12.770	1.428

The results in Table 1 show that boys had a higher mean of 15.51 with a corresponding standard deviation of 4.794 than girls who got a mean of 14.34 with corresponding standard deviation of 7.979. This low total means score of 29.85 shows that the level of biology scientific creativity is low.

Further analysis; test for significance (t-test, 2-tailed) for the difference in attainment of boys and girls in the entire sample was done to determine whether the difference in the mean scores of the boys and girls was statistically significant. Results are shown in Table 2

Table 2
Test of significance (t-test, 2-tailed) for the difference in performance between boys and girls in biology scientific creativity test (BSCT)

	t	df	Sig.(2- tailed)	Mean Difference	N
Equal variances assumed	1.129	316	0.260	1.175	320
Equal variances not assumed	1.129	258.50	0.260	1.175	320

The difference is not significant at the 0.05 level.

The result in Table 2 shows that the t- value (320) = 1.129, p > 0.05 hence there is no statistically significant difference in the scores attained by boys and girls in the biology scientific creativity test. Therefore, Ho2 is retained.

Independent sample t-test results of the difference between girls and boys for various aspects of biology scientific creativity

Table 3 below gives the results by gender on each aspect of scientific creativity.

Table 3

Creativity Aspect		t-value	df	Sig (2-tailed)
Sensitivity	Equal variances assumed	2.479	316	.014
	Equal variances not assumed	2.479	310.028	.014
Recognition	Equal variances assumed	-.669	316	.505
	Equal variances not assumed	-.669	310.612	.505
Flexibility	Equal variances assumed	-1.459	316	.147
	Equal variances not assumed	-1.459	292.644	.147
Planning	Equal variances assumed	.299	316	.765
	Equal variances not assumed	.299	312.726	.765

Table 3 shows that the difference in the means scores of performance in sensitivity to problems aspect of girls and boys were statistically significant at 0.05 level of significance. This is because the p-value of .014 is less than 0.05. t (320) = 2.479, p<0.05. On the other hand the difference in the means scores of performance in recognition, flexibility and planning aspects of scientific creativity of girls and boys were not statistically significant at 0.05 level of significance. This is because their p-value are greater than 0.05.

Creativity level in biology

Level of creativity in biology was measured by the Biology Scientific Creativity Test (BSCT). Learners' raw scores on biology creativity test were expressed in percentages. The scores were then categorized into 2 categories high and low with the criterion reference of 40%. Those who scored 40% and above were categorized as highly creative, while those who scored less than 40% were categorized as having low scientific creativity. Results of this analysis are shown in Table 4.

Table 4
Number and percentage of students and categories of creativity

Creativity	Number	%
High	16	5
Low	304	95
Total	320	100

Table 4 indicates that the level of scientific creativity in Biology education is low since only 5% of all the students managed to score 40% and above was categorized as high level of scientific creativity. Majority of the students 95% scored below 40% which categorized as a low level of scientific creativity. From this results then it was concluded that the level of scientific creativity in Biology education is low.

Discussion of results

The result in Table 1 shows that students of neither gender can be said to be better than the other in scientific creativity in biology despite boys having a mean that is slightly higher than that of girls. This implies that there is no relationship between gender and scientific creativity in biology education.

Research on gender differences in creativity carried out includes those on creativity test scores, creative achievements, and self-reported creativity. Creativity is reviewed, as are the theories that have been offered to explain such differences and available evidence that supports or refutes such theories.

This is a difficult area to conduct research because of the consistent lack of gender differences both in creativity test scores and in the creative accomplishments of boys and girls. (Baer, 2006) As a result it is difficult to show how innate gender difference in creativity could possibly explain later differences in creative accomplishments. At the same time the large difference in the creative achievement of men and women in many fields make blanket environmental explanations that have been proposed thus far are at best incomplete.

The results of this study show that boys had a higher mean score in scientific creativity in biology than girls. These findings are in agreement with studies carried out on biology students by Ndeke (2002) which found that boys had a higher mean score than girls. Likewise, Torrance (1983) found that gender differences in divergent thinking ability have changed over time. In the 1950's and 1960's boys outperformed girls on measures of originality, whereas girls surpassed boys on elaboration and most measures of verbal creativity (Torrance, 1962, 1965).

However the difference in means between boys and girls are not statistically significant meaning that gender has no influence on scientific creativity in biology education. These results are not in agreement with findings by Ndeke (2002) and Hungi (2009) in biology and Okere (1986), (1988) who found that there was a statistically significant relationship between scientific creativity and gender in favour of boys. They found out that in biology and physics scientific creativity was gender dependent. They also found out that the difference in scientific creativity in biology and physics was statistically significant in favour of boys.

The Relationship between Scientific Creativity in Biology Test and Culture

Scientific creativity in biology was measured by the Biology Scientific Creativity Test (BSCT) while Student's Culture Evaluation Questionnaire (SCEQ) was used to measure cultural practices, beliefs and values in the Turkana culture. Learners' scores in BSCT and SCEQ were expressed in percentages, means were also calculated. The SPSS programme was used to compute the Chi- Square test for the scores obtained from the two scores. The results are shown in table 5

Table 5
Chi-square tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-square	545.321[a]	442	0.001
Likelihood Ratio	344.352	442	1.000
Linear by linear association	6.674	1	0.010
N of Valid Cases	320		

The relationship is statistically significant at 0.05 level.

The results of the analysis showed that there was statistically significant relationship between scientific creativity in biology education and turkana culture. This is because r = 545.321, p= 0.001. This implies that there is a strong relationship between culture and scientific creativity in biology education. The relationship was identified as being statistically significant at 0.05 level. This means that when learners focus on their cultural practices, beliefs, rules and values it leads to low scientific creativity in biology education. Therefore the Ho1 is rejected.

Discussion of results

The results in Table 4 show that there is a strong relationship between learners' culture (practices, rules, beliefs and values) and scientific creativity. This means there are some cultural practices that may be hindering or stifling biology scientific creativity in secondary schools. These include lack of freedom to explore in risky activities, lack of questioning, corporal punishment, and lack of motivation, strict rules and demand for obedience.

These findings are in agreement with other researchers. A given culture may contain some elements that foster creativity and others that stifle it, yielding an overall influence that may be positive, negative, or neutral. (Sternberg, 1999).

Creativity may be fostered or hindered by cultural features such as individualism or collectivism and the value placed on conformity or tradition (William, Saiz, Formyduval, Munick, Fogle, Adom, Hague, & Yu, 1995). Triandis, McCusker, Bentancourt, Sumiko, Leung, Salazar, Setiadi, Sinha, Tozard & Zaleski (1993), suggested that individualist cultures value independence and self-reliance, which are important factors that foster creativity, whereas collectivist cultures emphasize obedience, cooperation, duty and acceptance of an in- group authority which stifle creativity. Ng (2001) proposed that the individualism – collectivism dimension can explain to a large extent differences in creative abilities levels for Westerners and Asians.

The worldview and values of a culture can affect the overall level of creativity. A culture can influence the amount of creativity through its emphasis on individuality as opposed to collective interest, through its tolerance of deviance as opposed to emphases on conformity (Lubart & Georgsdottir, 2004). According to Berry, Ype, Seger, Athanasios and David (1992) cultural values that foster creativity are perseverance, tolerance to ambiguity, and risk taking. Adams (1986) on the other hand gave several factors that may hinder creativity as "Fantasy and reflection are a waste of time", "Playfulness is for children only", "There is a right answer", and "Reason, logic, numbers, utility, and success are good while intuition, emotions, qualitative thinking, and failure are bad".

Creativity is more than a purely a cognitive phenomenon. Certain personality traits are particularly relevant for original, adaptive thinking development during childhood (Lubart & Georgsdottir (2004). Traits of risk taking, openness, individuality, perseverance and tolerance to ambiguity seem to play a role in creativity (Sternberg & Lubart, 1995). Therefore a culture that promotes these traits in children is likely to foster creativity unlike the one that does not. Gardner (1999) stated that people are creative when they can solve problems, create products, or raise issues in a domain in a way that is initially novel but is eventually accepted in one or more cultural settings. Gardner's views seem to support the idea that creativity can take different forms in different domains. Thus it may be conceptually and practically important to know about the differences as well as similarities of creativity in different cultures.

Conclusions

Specifically, the following conclusions were reached:

1. The level of scientific creativity in Biology education in Kenyan Secondary Students is low.
2. Scientific creativity is not influenced by a learners' gender.
3. Culture influences scientific creativity in Biology Education.

Implications of the findings and recommendations

The findings of this study suggested that the level of scientific creativity in Biology is generally low. This was attributed to some cultural rules and practices as well as cultural values in the Turkana culture. Creativity may be fostered or hindered by cultural features such as individualism or collectivism and the value placed on conformity or tradition (William, Saiz, Formyduval, Munick, Fogle, Adom, Hague, & Yu, 1995). According to Triandis, McCusker, Bentancourt, Sumiko, Leung, Salazar, Setiadi, Sinha, Tozard & Zaleski (1993), individualist cultures value independence and self-reliance, which are important factors that foster creativity, whereas collectivist cultures emphasize obedience, cooperation, duty and acceptance of an in- group authority which stifle creativity. Ng (2001), proposed that the individualism – collectivism dimension can explain to a large extent differences in creative abilities levels for Westerners and Asians.

The worldview and values of a culture can affect the overall level of creativity. A culture can influence the amount of creativity through its emphasis on individuality as opposed to collective interest, through its tolerance of deviance as opposed to emphases on conformity. (Lubart & Georgsdottir, 2004). According to Berry et al, 1992, cultural values that foster creativity are perseverance, tolerance of ambiguity, and risk taking. Adams (1986) on the other hand gave several factors that may hinder creativity as "Fantasy and reflection are a waste of time", "Playfulness is for children only", "There is a right answer", and "Reason, logic, numbers, utility, and success are good while intuition, emotions, qualitative thinking, and failure are bad".

Creativity is more than a purely a cognitive phenomenon. Certain personality traits are particularly relevant for original, adaptive thinking development during childhood. (Lubart & Georgsdottir (2004). Of importance, traits of risk taking, openness, individuality, perseverance and tolerance to ambiguity seem to play a role in creativity (Sternberg & Lubart, 1995). Therefore a culture that promotes these traits in children are likely to foster creativity unlike those who do not. The above mentioned traits were found to be highly discouraged in the Turkana culture especially as children are growing up hence stifling creativity in the learners'. Amabile (1983) findings of research in educational institutions system of reward and punishment found that it hinders creativity. He explains that knowledge of one "right answer" reduces room for imagination and more innovation.

In Turkana culture reward and punishment was highly applied stifling creativity among children. Therefore to improve on scientific creativity in Kenyan secondary schools in order to achieve vision 2030, the government should reform educational systems to adapt to rapid societal changes. These findings provide valuable information to policy makers, curriculum developers and implementers so foster positive cultural practices that enhance scientific creativity in learners.

The findings of this study further pointed that there was no statistically significant difference in scientific creativity in Biology education among the genders. The boys were found to be creative than the girls. It is hoped that this study will extend the ideas and findings reported in ways that will enrich our understanding of why there have been so much prominent men than women among those of the highest creative accomplishment. This will go a long way in helping in restructuring our schools and curriculum which will lead to less waste of human creative talent (Helson, 2004; Simonton, 1994). Therefore these findings may help in elimination of cultural blocks that limit creativity thereby leading to greater creative works and ideas in sciences necessary for industrial development and attainment of vision 2030.

References

Abra, J., & Valentine – French, S. (1991) Gender differences in creative achievement: A survey of explanation. Genetic, Social & General Psychology Monographs, 117(3), 235-284.

Adams, J. L. (1986). Conceptual blockbusting, a guide to better ideas. (3rd ed.). New York: Addison-Wesley. (Original work published, 1974)

Adams-Price, C.E. (1998), ed. Creativity and Successful Aging. New York: Springer.

Ai, X. (1999). Creativity and academic achievement: An investigation of gender differences. Creativity Research Journal, 12 (4), 329-337.
Akinwale, A.O. (2004). The Nigeria theatre and Cultural development. In P.A. Dopamu (Ed) African culture, modern science and religious thought. Ilorin: African Centre for Religion and Science.
Alters, B.J., & C.E. Nelson (2002). " Perspective: Teaching Evolution in Higher Education." Evolution 56 (10): 1891-1901.
Amabile, T. (1996). Creativity in Context. Update to the social psychology of creativity American Psychology. 56 (4), 333-335
Anmuah-Mensah, J. (1998). Native science beliefs among Ghanaian students.International Journal of Science Education. Vol. 20 No. 115-124.
Atkinson, J. & Hammersley, M. (1994). 'Ethnography and participant observation', in N.K Denzin and Y.S. Lincoln (eds), Handbook of Qualitative Research.Thousand Oaks, CA: Sage. Pp. 248-61.
Ausubel, D.P., Novak, J.D., & Hensian, H. (1978). Educational psychology: A cognitive view. New York, NY: Holt, Rinehart and Winston.
Baer, J. (2006). How early school experiences impact creativity. In Kaufman J.C. & Baer J. (Eds), creativity and Reason in cognitive Development. New York, NY: Cambridge University Press.
Barron, F. & Harrington, D.M (1981), Creativity, intelligence, and personality, Annual review of psychology, 32, 439-476.
Beghetto, R.A (2007). Does creativity have a place in classroom discussion? Teacher responses and preferences. Thinking skills and creativity 2 (i), 1-9.
Berry, W.J., Ype, H.P., Seger, M.B., Athanasios, C., & David, L.S. (1992). Cross-cultural psychology: Research and applications. New York: Cambridge University Press Available online http://www.americanscience.org
Boden, M.A (2001). Creativity and Knowledge. In A. Craft, B. Jeffrey, & M. Leibling (Eds), creativity in education. London Continuum.
Boden, M.A (2004). The creative Mind: Myths and Mechanisms. New York, NY, USA: Routledge.
Borg, W.R. & Gall M.D. (1989). Educational research (5th edition) New York, Holt, Rinehart and Winston, inc.
Chan, D.W. (2005). Self-perceived creativity, family hardiness, and emotional Intelligence of Chinese gifted students in Hong Kong: Journal of Secondary Gifted Education, 16, 47-56.
Cobern, W.W. (1993). A co-operative research Group for the study of culture and science education in developing countries. Paper presented at the UNESCO International conference on science education in developing countries. Jerusalem Israel (6th Sept, 1992).
Cohen, L., Manion L., & Keith, M. (2007). Research Methods in Education. New York,NY, USA: Routledge
Coone, J.G. (1969). A cross-cultural study of sex differences in the development of selected creative thinking abilities (Doctoral dissertation, University of Georgia,1968). Dissertation Abstracts International, 29, 4828B. Available online http://www.americanscience.org americansciencej@gm 112ail.com
Costa, P. T., Terracciano, A., McCrae, R.R., Pers Soc Psychol, J. (2001). Gender Differences in Personality Traits across Cultures: Robust and Suprising Findings; 81 (2): 322-31.
Cox, B.F. (2003). The relationship between creativity and self-directed learning among adult community college students. Unpublished doctoral dissertation, University of Tennessee.
Cropley, A. J. (1999). Definitions of Creativity. In M.A. Runco & S.R. Pritzker (ed) Encyclopaedia of Creativity. San Diego: Academic Press, pp. 511-522.
Csikszentmihalyi, M. (1996). Creativity: Flow and the psychology of discovery and invention. Harper Collins.
Draeger, W. (1991). Innovation – Invention – Kreativitaet: Durch Erneuerung zum Erfolg – ein Leitfaden fuer den kreativen Ingenieur und unternehmer. Duesseldorf.Germany: VDI – Verlag.
Ebel, R.L & Frisble, D.A. (1991). Essentials of Educational Measurement. Prentice Hall, Jersey. Fetterman, D.M. (1989). Ethnography Step by Step. Newbury Park, CA:Sage.
Forisha, B.L. (1978). Creativity and imagery in men and women: Perceptual and Motor Skills, 47, 1255-1264.
Frankel, J.R & Wallen, N.E. (1990). How to design and evaluate research in education. New York: McGraw-Hill Inc.
Frome, P.M., & Eccles, J.S. (1998). Parents' Influence on Children's Achievement-Related Perceptions. American Psychological Association Inc. 0022-3514/98/53.00. Journal of Personality and Social Psychology 1998. Vol. 74, No.2, 435-452.
Gabor, P. (2005). Scientific creativity in Hungarian context. Hungarian Studies, Akademiai Kiado. Vol.19. No. 2 Dec., 2005.
Gall, M.D., Gall, J.P., & Borg R.W. (2007). Educational Research: An Introduction (8th Edition). Pearson Education Inc.
Gardner, H. (1999). Intelligence reframed: Multiple intelligences for the twenty-first century. New York, NY: Basic books.

Gardner, H. (2010). Five minds for the future. Cambridge, MA: Harvard Business SchoolPress.
Goldsmith, R.E & Matherly, T.A. (1988). Creativity and self-esteem: A multiple operationalization, validity study: Journal of Psychology, 122, 47-56.
Gonzalez, N., Noll, L.C. & Amanti, C. (2005): Funds of Knowledge: Theorizing Practices in Households and Classrooms. Lawrence Erlbaum Associates.
Guilford, J. P. (1950). Creativity. American Psychologist, 5, 444-454.
Guiso, L., Monte, F., Sapienza, P., & Zingales, L. (2008). "Culture, Gender, and Math". Science, 320 (5880): 1164-1165.
Habermas, J. (1987). TheTheory of Communicative Action. (Volume two). Lifeworld and systems: A critique of functionalist reason. Boston: Beacon Press.
Harris, M., & Johnson, O. (2000). Cultural Anthropology, (5th ed.), Needham Heights, MA: Allyn and Bacon.
Hazari, A., Tai, R.H., & sadler, P. M.(2007). Gender differences in introductory university physicis performance: the influence of high school physics preparation and affective factors. Science education, 91(6), 847-877.
Heidegger, M. (1962). Being and Time (John Macquarrie and Edward Robinson, Trans).London: Routledge and Kegan Paul.
Helson, R. (1990). Creativity in women: Outer and inner views overtime. In Runco, M.A & Albert, R.S. Theories of creativity (pp 46-58). Newbury park, CA: Sage
Henderson, S.J. (2003). The correlates of inventor, motivation, creativity and achievement. Unpublished doctoral dissertation. Stanford University.
Hodson, D. (2003). In search of a rationale for multicultural science education. Science Education,77. 685-711.
Hu, W. & Adey, P. (2002). A scientific Creativity test for secondary school students:International Journal of science Education, Vol. 24, 389-403.
Ingels, S.J., & Dalton, B.W. (2008). Trends among High School Seniors, 1972- 2004(NCES 2008-320). Washington, DC: National Center for Education Statistics, Institute for Education Sciences, U.S. Department of Education.
Kathuri, N.J. & Pals, D.A. (1993). Introduction to Educational Research. Education Medic Centre (EMC). Egerton University, Kenya.
Kaufman, J.C., & Baer, J. (2006), Gender differences in creativity: Journal of Creative Behaviour, 42 (2), 75-105.
Kaufman, J.C., & Baer, J. (2006), Gender differences in creativity: Journal of Creative Behaviour, 42 (2), 75-105.
Kenya National Examination Council (KNEC), (2010): 2009Kenya Certificate of Secondary Education examination report. Nairobi, Kenya: KNEC.
Kim, U. (2007). Creating a world of possibilities. Indigenous and cultural perspectives. In Tan Al-Girl (Ed) creativity: A handbook for teachers' world scientific publishing Co. Pte. Ltd.
Kogan, N. (1974). Creativity and sex differences: Journal of Creative Behaviour, 8 (1), 1-14, Available online http://www.americanscience.org americansciencej@gm 112 ail.com.
Kraft, C.H. (1998). Culture, worldview and contextualization. Retrieved August 29, 2013, from http://www.mysite.verizon.net
Lindlof, T.R., & Taylor, B.C. (2002). Qualitative Communication Research Methods, 2nd edition. Thousand Oaks, CA: Sage. Loehle, C. (1990). A guide to increased creativity in research-inspiration or perspiration in Garfield, E. Current comments essays of an information scientist: Journalogy (13): 240. Institute for Scientific Information. Philadelphia.
Lubart, T.I. & Georgsdottir, A. (2004). Creativity: Developmental and Cross-cultural Issues. In S. Lau, A.N. Hui, & G.Y, Ng (Eds) Creativity: When East meets West.Singapore: World Scientific.
Lubart, T.I. (1999). "Creativity across culture," in Handbook of Creativity, Robert J. Sternberg(ed). New York, NY: Cambridge University Press, 339-350
Mason, C.L. (1992). "Concept Mapping: A Tool to Develop Reflective Science Instruction." Science Education 76 (1): 51-63.
Maundu, J.N., Sambili, H.J., & Muthwii, S.M. (1998). Biology Education: A methodological Approach. Lectern Publications Ltd.
McComas, W. (1998). The principle element of the nature of science and spelling the. In McComas (ed) The nature of science in science education: Rationales and strategies (53-72) Dordrecht. The Netherlands KLywer.
Montouri, A., & Purser R.E (1999), Social Creativity. Cresskill, NJ, USA: Hampton.
Moravcsik, M.J. (1981). Creativity in science education. Science Education; 65, 221-227.
Mpofu, E., Myambo, K., Mogaji, A.A., Mashego, T., & Khaleefa, O. H. (2006). African Perspectives on Creativity. In Kaufman, J.C and Sternberg R.J (eds). The International Handbook of Creativity. Cambridge University Press. ISBN 0-521-54731-8

Mumford, M.D. (2003). Where have we been, where are we going? Taking stock in creativity research. Creativity Research Journal, 15, 107-120. doi: 10. 1080/ 10400419.2003.9651403.

National Advisory Committee on Creative and Cultural Education (NACCCE). All ourfutures: Creativity, Culture and Education, Department for Education and Employment, London, 1999. Retrieved August 29, 2013 from http://www.cypni.org.uk/downloads/alloutfutures. .

Ndeke, G.C.W. (2003). The effects of gender, knowledge and learning opportunities on scientific creativity amongst form three biology students in Nakuru District:Unpublished Masters Thesis. Egerton University.

Ndeke, G.C.W., & Okere, I.O.M. (2012). Influence of gender and Knowledge on Secondary School Students' Scientific Creativity Skills in Nakuru District, Kenya. European Journal of Educational Research, Vol 1, No. 4, 353-366.

Neuman, W.L. (1994). Social Research Methods: Qualitative and Quantitative Approaches. (2nd ed). Boston: Allyn and Bacon.

Ng, A.K. (2001). Cultural influences on task-oriented/creative behavior and ego oriented/ conforming behavior: Two theoretical models. The Second International Symposium and Child Development, Hong Kong, June 26-28.

Niu, W. (2006). Development of Creativity research in Chinese Societies. In Kaufman J.C and Sternberg, R. J. (eds). The International Handbook of Creativity. Cambridge University Press. ISBN 0-521-54731-8.

Obioha, P. (2010). "Globalization and the Future of African Culture" Philosophical Papers and Reviews, Vol. 2 (1). http://www.academicjournals.org/PPR99 . The Journal of Pan African Studies, vol. 4, no. 3, March 2011.

Odhiambo, T.R. (1972). Understanding of science. The impact of the African view of nature. In Gilbert P.G. & Lovegrove, M.N. (eds), Science education in Africa, (pp 39-46). London: Heinemann Educational Books ltd.

Ogawa, M. (1986). Towards a new rationale of science education in non- Western Society: European Journal of Science Education Vol.8, pp113-119.

Ogunleye, O.O. (2009). Globalization and its challenges to African cultures and values.In Ivowi, U.M.O (Ed) Education for Value. Lagos: The CIBN Press Limited.

Ogunniyi, M.B. (1988). Adapting western science to traditional African culture.International Journal of Science Education, 10 (1): 1-9.

Okere M.I.O., Changeiywo, J. & Illa, T.A. (2010). Effects of Concept Teaching Strategy on students' creativity in physics education in Nyando District, Kenya: Egerton Journal Humanities, Social Sciences and Education, Vol. IX, 157-170.

Okere, M.I.O. (1986). Creativity in physics Education. Unpublished PhD Thesis, University of London.

Okere, M.I.O., & Keraro, F. N. (2002). Cultural influences on childhood science education. The Kenyan Experience. Egerton Journal, Humanities, Social sciences and education series, 4, 141-153.

Onwuegbuzie, A. J., & Johnson, R. B. (2004). Validity issues in mixed methods research. Paper presented at the annual meeting of the American Educational Research Associations,San Diego, CA.

Onwuegbuzie, A. J., & Leech, N. L. (2004). On becoming a pragmatic researcher: The importance of combining quantitative and qualitative research methodologies.Manuscript submitted for publication.

Osborne, J., Collins, S., Ratcliffe, M., Millar, R., & Duschl, R. (2003). What "ideas about science" should be taught in school science? A Delphi study of the Expert community Journal of Research in science teaching. Vol. 40 (7): 692-720.

Paulaus, P.B., & NijStad, B.A. (2003). Group creativity: Innovation through collaboration. Oxford, UK: Oxford University Press.

Piirto, J.A. (1999). Survey of psychological studies in creativity. In Fishkin A.S. & Crammond B. (Eds), Investigating creativity in youth: Research and Methods.(pp. 27- 48)

Piirto, J.A. (2004). Understanding creativity. Scottsdale, AZ: Great Potential Press.

Pink, D.H. (2005). A whole new mind: Moving from the information age into the conceptual age. Allen & Unwin.

Richard, K.H., & Osborne, M.D. (2004). Finding Meaning in Science: Lifeworld, Identity, and self. Science Education. 88: 157-181.

Schmader, T., Johns, M., & Barquissau, M. (2004). The costs of accepting gender differences: The role of stereotype endorsement in women's experience in the math domain. Sex Roles: A Journal of Research, 50, 835-850.

Schmidt, A. (2011). Creativity in science: Tensions between perceptions and practice Creative Education. 2, 435-445. doi: 10.4236/ce.2011.25063.

Shumba, O. (1995). Science teachers' assessment of the interaction of indigenous African culture with science education in Zimbabwe Journal of Educational Research, 7 (3), 258-299.

Simonton, D.K. (1994). Greatness: Who makes history and why. New York: Guilford.
Simonton, D.K. (1997). Creative productivity: A predictive and explanatory model career trajectories and landmarks: Psychological review 104 (1): 66-89.
Sternberg, R.J., & Lubart, T. I. (1995). Defying the Crowd: Cultivating creativity in a culture of conformity. New York. Free Press.
Sternberg, R.J., & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms in ed, Sternberg, R. J., Handbook of creativity. Cambridge University Press.
Taylor, C.W. (1988). Various approaches to and definitions of creativity in ed.
Tegano, D.W., & Moran, J.D. (1989). Sex differences in the original thinking of preschool and elementary school children: Creativity Research Journal, 2 (1-2), 102-110.
Tobin, K. (1988). Differential Engagement of Males and Females in High School Science International Journal of Science Education. 10 (3): 239-252.
Torrance, E.P. (1974). Torrance tests of creative thinking. Personnel Press. Von Franz, Marie-Louise, Psyche and Matter (Shambhala, 1992).
Torrance, E.P. (1983). Status of creative women: Past, present, and future. Creative Child and Quarterly, 8 (3), 135-144, US. Department of education (1991).
Trautmann, M. (2012). TopTen Definitions of Creativity. Retrieved November 12, 2013. From http://celestra.ca/top 10-creativity-definitions/.
Treffinger, D. (2001). Creative learning today. Centre for creative learning Sarasota, Inc.
Triandis, H.C. (1996). The psychological measurement of cultural syndromes. American psychologist, 51 (4), 407-415.
Triandis, H.C., McCusker, C., Bentancourt, H., Sumiko, I., Leung, K., Salazar, J.M Setiadi, B., Sinha, J.B.P., Tozard, H., & Zaleski, Z. (1993). An etic- emic analysis of individualism and collectivism. Journal of Cross-Cultural Psychology, 24 (3),366-383.
Tylor, E.B. (1974). Primitive culture: researches into the development of mythology, philosophy, religion, art and custom. New York: Gordon Press. First published in 1871. ISBN 978-087968-091-6
UNESCO. (1999). Declaration on Science and the Use of Scientific Knowledge. Text adopted by the World Conference on Science. Retrieved November 12, 2013 from http://www.unesco.org/science/wes/declaration-e.htm.
UNESCO. (2002). Universal Declaration on Cultural Diversity, Issued on International Mother language Day. ISBN. 978-0-87968-091-6.
Vernon, P.E. (1989). The nature- nature problem in creativity. In J.A. Glover, R.R. Ronning & C.R. Reynolds (eds) Handbook of creativity: perspectives in individual differences. NY. Planum Press.
Warren, G.H., & Luria, Z. (1972). Evaluational set and creativity. Perceptual Motor skills, 1 (2), 436-438.
Welle-strand, A., & Tjeldroll, A. (2003). Creativity, curricula and paradigms. Scandinavian Journal of Educational Research, 47 (3), 359-372.
William, C.O. (2006). “Culture Contact and Global Development: An African Experience” Oye: Ogun Journal of Arts, Vol. XII. 100. The Journal of Pan African Studies, vol.4, no.3, March 2011.
William, J.E., Saiz, J.L., Formyduval, D.L., Munick, M.L., Fogle, E.E., Adom A., Hague, A., Neto, F., & Yu, J. (1995). Cross-cultural variation in the importance of Psychological characteristics: A seven-country study: International Journal of psychology, 30 (5), 529-550.
Witz, K.G. (2000). “The ‘Academic’ problem.” Journal of Curriculum studies, 32: 9-23.