TEACHERS' PERCEPTIONS OF CLASSROOM PRACTICES THAT INCULCATE SCIENTIFIC CREATIVITY

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ABSTRACT

This paper reports a study that investigated secondary school biology teachers' perceptions of classroom practices that inculcate scientific creativity among their learners. A sample of 205 teachers was selected from a population of 347 in Kericho and Kajiado Counties, Kenya using Stratified proportionate sampling technique. Data was collected using Biology teachers' questionnaire and an observation schedule. The findings show that most teachers felt they included classroom activities that would inculcate scientific creativity in learners. This, however, was inconsistent with observations made in their lessons. It is recommended that science teacher education programmes and policy makers put more emphasize on teachers' acquisition of knowledge and skills that would enhance learners' scientific creativity.

Keywords: Biology, Classroom practices, Scientific creativity, Teachers' perceptions

INTRODUCTION

Creativity is beneficial for both the individual and society (Bereczki & Kárpátì, 2017). At the individual level, creativity is a universal characteristic of self-actualization, which allows for full use and exploitation of talents, capacities, and potentials (Maslow (1987). At the society level, creativity plays a critical role in the social, economic and technological development of any country. According to Craft (2010), economic, social and technological challenges of any country can be overcome using creative thoughts and solutions, which would in turn influence the future of a country (Siew & Chin, 2018). Gibson (2010), points out that creativity is a means to solving social and economic problems facing the 21st century. According to Falconer, Cropley and Dollard (2018) this century is characterised by technological advances, unpredictability and unfamiliar demands. Therefore, creativity should be at the heart of learning so as to foster enduring skills that are required. According to the National Education Association (2010) creativity is one of the 21st century skills required by all.

The Government of Kenya through its economic blue print, Vision 2030 aims at transforming the country into an industrialized middle-income state by the year 2030 (Government of Kenya [GOK], 2007). In order to meet the demands of the Vision, the education sector should provide a globally, competitive quality education, training, and research for sustainable development (GOK). Vision 2030 recognizes the role of science in a modern economy by noting that, a knowledge economy is always associated with an increase in science and technological related activities. Hu, Sui, Han, Wang and Adey, (2010), note that scientific creativity as one of the most important contributing factors to the advancement of human civilisation.

According to Cramond (2001), creativity is a multidimensional construct that all people demonstrate to some degree. Häyrynen (2009), supports this argument by noting that

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creativity is an innate element of human practice assigned to all persons. This implies that all learners can acquire creativity skills if teachers provide an enabling environment. Creativity is also described as the application of knowledge and skills in new ways to realise a valued objective (Seltzer & Bentley, 1999). This requires learners to have the ability to identify new problems, rather than depending on others. Creativity also requires learners to possess the ability to apply knowledge gained in one context in another in order to solve a problem. Sternberg and Lubart (1999), note that creativity is the ability to produce work that is both novel and appropriate, in which the new is sometimes a product, person or process. This is supported by BjΦrner and Kofoed (2013); Hu and Adey (2002), who points to creativity to include three aspects; the creative product, creative process and the individual person.

Scientific creativity is seen as the attainment of new and unique steps in achieving the objectives of science (Moravcsik, 1981). Moravcisk further contends that creativity can manifest itself in the conception of new ideas contributing to scientific knowledge. This is usually in the formulation of new theories of science, in the devising of experiments to probe nature's law and in the development of scientific ideas applied to particular domains of practical interest. He further argues that knowledge is open and that creativity lies in adding new components to this knowledge, which is a fundamental assumption ignored in science education. Scientific creativity requires background knowledge and domain skills (Liang, 2002). Liang further argues that knowledge in the science domain includes science content knowledge itself and knowledge about the nature of science. The foregoing literature shows that leaners' acquired scientific knowledge can be applied in identifying problems and looking for possible solutions to the problems within their context.

Alsahou (2015), contends that fostering creativity through school subjects is the focus of many educational policy makers and educationist as it prepares learners to overcome future challenges. This is supported further by Adzliana, Omar, Turiman & Osman (2012) who contend that educational institutions are the most important environments in which to nurture learners' creative minds. Teachers play a critical role in the promotion of scientific creativity skills among their learners. According to Cremin (2009), teaching for creativity involve teachers' identifying learners' creative strengths and fostering their creativity. However, Cropley (2001), notes that educational instructions limit their role to transmitting knowledge and skills to learners' yet these change with time hence what is needed for the future may not be predictable. Therefore, teachers need to prepare leaners for the unpredictable future by giving them the right skills to identify problems and come up with possible solutions to the problems. But for teachers to cultivate the creative skills in their learners they need knowledge about the teaching for creativity (Adzliana, Omar, Turiman & Osman).

Teachers' perceptions of scientific creativity determines what classroom activities they provide for learners (Newton & Newton, 2009). Kind and Kind (2007) identified the use of practical work and inquiry based science teaching as some of the activities that can be adapted by science teachers to foster creativity in science. In Kenya, the science curriculum which includes Biology has many suggested practical activities for learners. However, most of these activities are confirmatory experiments which give minimal room for learners to develop their creative skills. In many schools and classrooms, creativity has been marginalized (Beghetto & Plucker 2006; Sternberg 2003), due to the lack of resources, competing circular demands and problematic beliefs and misconceptions about creativity (Plucker, Beghetto & Dow 2004; Aljughaiman and Mowrer-Reynold, 2005, Beghetto, 2007). Gupta and Sharma (2019) point out that the undesirable effects of deficiencies in resources, limited infrastructure and high student ratio can be overcome if teachers are motivated to look

at science teaching from an unconventional perspective. Therefore, science teachers can improvise the suggested practical activities to allow learners to be creative.

From the foregoing discussion, it is evident that teachers play a critical role in enhancing scientific creativity among their learners. Hence this study sought to investigate classroom activities Biology teachers' engage their learners in during their lessons that are geared towards enhancing scientific creativity skills. Okere (1986) mapped the psychological definitions of creativity to the scientific meanings of creativity, indicating classroom activities that would enhance creativity in a science lesson. The definitions are classified into four main aspects; flexibility, sensitivity to problems, planning and recognition of relationships. These aspects are mapped to scientific meanings indicating classroom activities that inculcate scientific creativity. The scientific meanings guided the development of items both in the biology teachers' questionnaire and biology lesson observation schedule.

OBJECTIVE OF THE STUDY

The main objective of the study was to investigate biology teachers' perceptions of classroom activities that inculcate creativity in their learners. The perceptions were examined with regard to importance of creativity in the context of biology, teachers' role in enhancing creativity and classroom practices that enhance it in learners.

METHODOLOGY

The study employed descriptive cross sectional survey research design. The design involves collection of data at one point in time from a random sample that represents a given population at a particular time (Wiersma & Jurs, 2005). The design was appropriate for the current study since information was gathered at one point in time on the status of biology teachers in regard to their perceptions of scientific creativity and classroom practices that enhance them..

The study targeted Biology teachers from public secondary schools in Kericho and Kajiando Counties, Kenya. Each of the two counties has five sub counties. The study focussed on those teachers who had a minimum of three years' experience to ensure that they all had requisite teaching experience and pedagogical skills. A sample of 205 teachers was drawn from a total population of 347 teachers using proportionate random sampling technique. Kericho contributed 128 teachers from a population of 216, while Kajiado contributed 77 teachers from a population of 131. To ensure even distribution of the teachers in each sub county, a list of teachers from each sub county was drawn and used as a sampling frame. Simple random sampling technique was used to select the participating teachers.

Two instruments; A Biology teachers' questionnaire (BTQ) and Biology Lesson Observation Schedule (BLOS), were used to collect data from the Biology teachers. . The BTQ consisted of two sections. The first section consisted of three open ended items that were used to collect data on Biology teachers' views about the importance of creativity and their role in enhancing learners' scientific creativity. The items were open ended so that teachers could express their views in their own words. Their responses were analysed and categorised as valid or non-valid. Each valid response was then tallied and expressed as a percentage of the total. The second section consisted of thirteen (13) closed ended Likert type items that were used to measure teachers' perceptions of classroom practices that inculcate scientific creativity in their learners. The teachers used a five point scale; Never (0), Rarely (1), Sometimes (2), Often (3) and Always (4), to indicated the frequency of occurrence of specified activities in class during their biology lessons. These activities were further categorised into three aspects of scientific creativity, namely planning, sensitivity and recognition of relationships.

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The BLOS was used to gather information on teacher's actual classroom practices in a biology lesson that encourage development of creativity among learners. The purpose of observing the Biology lessons as learning was taking place was to record and compare if what teachers indicated in the BTQ they do, does actually occur during the teaching learning process. Direct lesson observation approach was used with emphasis being placed on the teacher and learners' behaviour that inculcated scientific creativity. The researchers recorded all the interactions that occurred during the lesson from which the interactions that were geared towards encouraging learners to be creative were identified. The recordings were done manually and video-taped to capture all the classroom activities. The recordings were later transcribed to ensure that no activity that occurred was left out during analysis. The activities were then categorized into four namely, flexibility, recognition of relationships, sensitivity and planning for investigations.

Experts in Science Education validated the instruments. After validation of the Biology lesson observation schedule, the researchers observed four (4) biology lessons in one school in Nakuru County. This was done to ensure the researchers were able to identify activities that are geared towards encouraging development of scientific creativity among learners during a lesson before embarking on the actual study. After validation of the BTQ, the instrument was pilot tested using 30 biology teachers in Nakuru County. The teachers in Nakuru County did not take part in the main study and hence no contamination. The results of the pre-test were used to estimate reliability of the instruments and refine them. The reliability of BTQ was estimated using Cronbach's coefficient alpha formula. The reliability coefficient of 0.794 was obtained. This was above the accepted threshold for social science research. Cronbach's coefficient alpha is appropriate because the items in BTQ were Likert type and had a range of scores. In addition, only one administration of the instrument is required (Gall, Gall & Borg, 2007).

Upon receiving research permit from National Commission for Science, Technology and Innovation, the researcher visited the Education Offices in Kajiado and Kericho respectively to notify them of the intention to collect data from schools in their areas of jurisdiction. The researcher then visited the sampled biology teachers in their respective schools through the respective principals and informed them of the purpose of the study.

The researchers self-administered the questionnaires' to the sampled biology teachers' to ensure higher return rate. Once all the questionnaires were collected, the data was analysed and the top 6 and 4 biology teachers in the BTQ, in Kericho and Kajiado County respectively, were purposively selected for lesson observations. Each of the ten (10) teachers was observed in four (4) biology lessons with two of the lessons being practical sessions. This gave a total 40 biology lesson, 24 in Kericho County and 16 in Kajiado County. The researchers sat in the classroom during the biology lessons and recorded all the classroom activities that occurred during the lesson. A video- tape recorder was also used to capture the lesson activities to ensure that all that occurred during the lessons were recorded. This enable the researchers to compare what was recorded in writing and what was video-taped. This continued for the entire period of the lesson, which was 40 minutes for a single lesson and 80 minutes for a double lesson. Both theory and practical lessons were observed in order to capture as many activities as possible.

RESULTS

Teachers were requested to read each item and respond to each item to their best of knowledge.

Item 1: Importance of creativity in the context of biology

In this item 12(5.9%) teachers were non-responsive, 16(7.8%) gave invalid responses while 177(86.3%) gave valid responses. Summary of the valid responses is presented in Table 1.

Table 1. Importance of Creativity in the Context of Biology

	Kajiado N=77		Kericho N=128		Overall N=205	
Importance of creativity	Frequency	%	Frequency	%	Frequency	%
Enhances knowledge and skill acquisition (interest, curiosity, understanding of difficult concepts)	46	59.7	84	65.6	130	63.4
Is a bridge to solving problems (application)	6	7.8	14	10.9	20	9.8
Enhances learners divergent/critical thinking ability	6	7.8	14	10.9	20	9.8
Assists learners build careers	2	2.6	5	3.9	7	3.4
Helps learners to be innovative/come up with something new (product or process)	6	7.8	23	18.0	29	14.1
Broadens learners imagination/thinking capacity	1	1.3	1	0.8	2	1.0
Encourages exploration/discovery	3	3.9	3	2.3	6	2.9
Improves performance in the subject	1	1.3	7	5.5	8	3.9

The results show that 14.1% of biology teachers indicated that creativity enhances innovations among leaners. Three point nine percent (3.9%) of teachers thought that creativity improves academic performance in the subject while 9.8% indicated that creativity help in solving problems.

Examples of invalid responses include:

i. Biology is a creative science
ii. Presents learners with a variety of challenges within their environment
iii. Enhances ones realization of vision 2030

Item 2: Teachers' role in enhancing learners' creativity

In this item, six teachers' were none responsive. Biology teachers' response to the above item are presented in Table 2.

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Table 2. Teachers' Response on Whether They Think They Have a Role in Enhancing Learners' Creativity

Response	Kajiado N=77		Kericho N=128		Overall N=205	
	frequency	%	Frequency	%	Frequency	%
Yes	73	94.8	124	96.9	197	96.1
No	1	1.3	1	0.8	2	1.0
Non-responsive	3	3.9	3	2.3	6	2.9

The results show that 96.1% of biology teachers thought that it is the responsibility of a teacher to enhance learners' creativity. Only 1% of teachers' thought that it is not their responsibility to enhance learners' creativity. Two point nine percent (2.9%) were non-responsive.

Biology teachers further gave reasons as to why they thought it is their role to foster creativity in their learners. In this item 20(9.8%) teachers were non-responsive, 54(26.3%) gave invalid responses and 131(63.9%) gave valid responses. The results indicate that although a high number of teachers (96.1%) indicated that it is their role to enhance learners' creativity, fewer teachers' (63.9%) could explain their role. The valid responses are presented in Table 3.

Table 3. Teachers' Role in Enhancing Learners' Creativity

	Kajiado N=77		Kericho =128		Overall =205	
Role	Frequency	%	Frequency	%	Frequency	Percent
Teachers create an environment where learners can express their creativity	14	18.2	16	12.5	30	14.6
Teachers act as a guide to learners	20	26.0	44	34.4	64	31.2
Teachers are role models to learners	3	3.9	6	4.7	9	4.4
They help in the moulding the learners to be divergent and critical thinkers	5	6.5	5	3.9	10	4.9
Help in equipping learners with scientific skills (problem formulation, solving)	2	2.6	4	3.1	6	2.6
Gives learners tasks that require exploration/discovery	2	2.6	1	0.8	3	1.5
Motivate students (encourage, make the subject interesting)	5	6.5	10	7.8	15	7.3
Facilitate acquisition of subject content which is a pre-requisite to creativity	5	6.5	6	4.7	11	5.4

The results indicate that 63.9% of teachers could explain their role in enhancing creativity among their learners. Only 31.2% of the teachers identified their role as that of guiding learners, 14.6% identified their role as providing an environment for learners to express themselves while 4.4% of teachers thought of their role as being models to learners. This implies that some biology teachers may be lacking knowledge on what their role is in enhancing creativity among their learners.

Examples of invalid responses:

i. The teachers instil basic concepts and show learners in experiments
ii. Through subject matter a concept is born and then the concept is put into practice
iii. The biology teacher should be there to measure creativity
iv. The teacher has content from where the student can experiment
v. By avoiding a know-it-all approach
vi. Encourage learner-centred method of teaching.
vii. Teachers give hints which foster creativity

Item 3: Classroom Practices in a Biology Lesson

In this section teachers were asked to indicate how often they practiced the thirteen provided activities during their lessons. The expected responses for this section were for teachers to indicate the frequency in which mentioned classroom activity occurs during their biology lessons. The responses ranged from never, rarely, sometimes, often to always. The scores ranged from 0 for never to 4 for always. A summary of their responses is presented in Table 4.

Table 4. Mean Scores and SD of Teachers' Classroom Practices

Category	Classroom Practice	Kajiado		Kericho		Total	
		Mean	SD	Mean	SD	Mean	SD
Recognition of relationship	Ask learners to explain relationships between concepts(generate hypothesis	2.68	.98	2.62	1.03	2.65	1.01
Recognition of relationship	Ask learners to select a correct hypothesis/explanations from given alternatives.	2.36	1.16	2.34	1.20	2.34	1.19
Recognition of relationship	Ask learners to explain causes of observations or events using one topic.	2.75	1.01	2.59	1.11	2.65	1.07
Recognition of relationship	Ask learners to explain causes of observations or events cutting across many topic areas.	2.68	.94	2.59	1.09	2.62	1.04
Recognition of relationship	Allow learners to develop own solutions to their problems	2.61	1.08	2.50	1.18	2.54	1.14
sensitivity	Ask learners to criticize experimental procedures.	1.74	.94	1.99	1.10	1.90	1.05
sensitivity	Ask learners to reformulate general statements into testable/measurable statements.	1.89	1.10	2.00	1.21	1.96	1.17
Sensitivity	Allow learners to identify problems to investigate on their own.	1.96	1.10	2.35	1.03	2.20	1.07

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Category	Classroom Practice	Kajiado		Kericho		Total	
		Mean	SD	Mean	SD	Mean	SD
Planning	Organize learners into groups for discussion	2.55	.72	2.95	.74	2.80	.76
Planning	Ask learners to identify variables in an experiment.	2.68	.96	2.72	1.06	2.70	1.02
Planning	Ask learners to device and describe experimental procedures.	2.49	1.08	2.67	1.02	2.60	1.04
Planning	Engage learners in project work	1.80	.96	2.35	1.10	2.15	1.08
Planning	Allow learners to brainstorm on an identified problem for possible solutions.	2.59	1.01	2.71	1.06	2.67	1.04
	Overall	2.37	.62	2.49	.63	2.44	.62

The results indicate an average practice of the classroom activities that do enhance scientific creativity among learners with an overall mean of 2.44. The activity with the lowest mean was on teachers asking learners to criticize experimental procedures (1.90), followed closely by where teachers ask learners to reformulate general statements into testable statements (1.96). The results also show that most biology teachers organized learners into groups for discussion (2.80), and asked learners to identify variables in an experiment (2.71). The organization of learners into groups is important especially for brainstorming (2.67) during investigations or experimental work.

Items on classroom practices were further categorized into three aspects of creativity, namely, planning sensitivity and recognition of relationships (Okere, 1986). The total score of each aspect of creativity was then converted to out of a maximum score of four. The difference between each aspect of creativity in Kericho and Kajiado was examined using the t-test. The Levene's test of equality of variances was conducted to ascertain that the underlying assumption of equality of variances between groups was not violated. The test results indicated that the variances were similar ($p>.05$). Thus it was appropriate to conduct the comparisons using the t-test. The t-test results are presented in Table 5.

Table 5. Differences in Teachers Perceptions' on Classroom Practices that Inculcate Scientific Creativity by County

Scale	County	N	Mean	SD	df	t-value	P-value
Planning	Kajiado	76	2.42	.64	201	2.76	.006
	Kericho	127	2.68	.66			
Recognition of relationships	Kajiado	76	2.62	.69	201	.95	.344
	Kericho	127	2.52	.70			
Sensitivity	Kajiado	76	1.86	.62	201	2.03	.044
	Kericho	127	2.11	.88			
Overall	Kajiado	76	2.38	.62	201	1.35	.180
	Kericho	127	2.49	.63			

The results in Table 5 indicate that biology teachers from Kericho county had the highest mean in planning (M=2.68), while teachers from Kajiado county had the highest mean in recognition of relationships (M=2.62). Both counties had their lowest mean on sensitivity

aspects with Kajiado recording the lowest mean (1.86). The results also show that the teachers had a higher perception on classroom practices geared towards planning (M=2.58), followed by recognition of relationship (M=2.56), with the lowest being in Sensitivity (M=2.02). This could be attributed to biology being a practical subject, therefore, involving many practical activities.

The t-test indicate a significant difference on the aspect of planning between kajiado (M=2.42, SD=0.64) and Kericho (M=2.67, SD=0.66); t(201) =2.76, p=0.006. On the aspect of sensitivity, there was a significant difference between Kajiado (M=1.86, SD=0.62) and Kericho (M=2.11, SD=0.88); t(201)=2.03, p=0.044. The level of significance was at alpha level of .05. However there was no significant difference in the aspect of recognition of relationship t(201)=0.95, p=0.344and the overall scientific creativity t(201)=1.35, p=1.80 between the two counties. The results suggest that teachers in Kericho perceived that they include more activities that inculcate the aspects of planning for investigations and sensitivity scientific creativity skills in their learners more than those from Kajiado. This difference could be attributed to the environment which may be influencing their perceptions.

Teachers' Observed Classroom Practices

The biology lesson observation schedule (BLOS) was used to observe 40 form two and three biology lessons. After computing the total score in the quantitative items measuring classroom practices in the biology teachers' questionnaire (BTQ), the top 6-biology teachers in Kericho County and 4 in Kajiado County, were selected to be observed during their lessons. Four (4) biology lessons were observed for each teacher giving 24 biology lessons in Kericho County and 16 biology lessons in Kajiado County. The researchers sat in the classroom during the biology lessons and recorded all the classroom activities that occurred during the lesson. The researchers also video-taped the lesson activities to ensure that all activities that occurred during the lesson was captured. This allowed the researchers to compare what was manually recorded and what was video-taped. This continued for the entire period of the lesson, which was 40 minutes for a single lesson and 80 minutes for a double lesson. Both theory and practical lessons were observed in order to capture as many activities as possible.

The aim of observing the biology lessons was to compare biology teachers' responses on classroom practices in BTQ and their actual classroom practices. This was to inform the study whether what biology teachers say they do does actually take place during the lessons. The classroom practices were categorized into four, flexibility, and recognition of relationships, sensitivity and planning for investigations. Each category was further categorized into teacher initiated or learner initiated activities. The results are presented in table 6.

Table 6. Categories of Classroom Practices that Encourage Scientific Creativity initiated by Teachers and Learners

Category	Initiated by a teacher	Initiated by a learner
Flexibility	▪ Asks for more than one response to a question ▪ Asks for different opinions or ways of carrying out an activity	▪ Identifying different observable characteristic in an organism ▪ Identifying different ways or procedures of carrying out an activity ▪ Make different observations and explanations of observed phenomenon
Recognition of	▪ Asks learners to identify	▪ When they classify organisms

Category	Initiated by a teacher	Initiated by a learner
relationships	relationships among living organisms ▪ Asks learners to account for observed phenomenon ▪ Asks learners to explain expected outcomes or observations ▪ Asks learners questions relating to structure and function or adaptations ▪ Asks on advantages or disadvantages of certain characteristics ▪ Asks learners to identify structure giving reasons ▪ Asks learners to identify sequence of activities in a process giving reasons for each activity ▪ Asks learners to identify similarities and differences in processes or structures	using observable characteristic ▪ When learners give reasons for observed phenomenon ▪ When learners explain the importance of a process in a living organism
Sensitivity	▪ Identify errors in learners responses ▪ Asks learners to identify limitations or assumptions of a certain procedure ▪ Asks learners to identify consequences if a process fails to take place as it should	▪ Identifying errors in from each other's responses ▪ Identifying sources of errors in following a given procedure ▪ Identify errors in handling of apparatus or equipment ▪ Identify errors in teachers statements or explanations ▪ Asks on exceptions of explained phenomenon e.g. haemophilia and blood clotting process ▪ Able to identify or make observations in an experiment
Planning for investigations	▪ Asks learners how to make certain measurements for example heartbeat	▪ Record and present data after an observation

The results show that teachers initiated most of the activities, which were mainly on recognition of relationships. On sensitivity, there were more learner-initiated activities than teacher initiated, which mainly dealt with identification of errors. However, no activity took place during biology lessons that required learners to identify testable statements and reformulate scientific statements into testable ones. Only one activity on planning for investigations was initiated by a teacher and one by a learner. This indicates that few activities take place during a biology lesson that are geared towards planning for investigations. At no time were learners required to identify variables in an experimental procedure or devise an alternative procedure of an experiment to the one provided. This

shows that learners were not provided with opportunities to enable them acquire skills on planning for investigations and instead have concentrated more on recognition of relationships.

DISCUSSION

The result reveal that most of the biology teachers had limited information on the importance of creativity in biology. Importance identified by teachers include; knowledge acquisition (63.4%), broadens imagination (1%), encouraged exploration (2.9%), and improves performance in the subject (3.9%). This is in agreement with Authors (2012) and Okere (1986) findings, which showed that creativity, had a statistically significant relationship with knowledge acquisition or academic performance in Biology and Physics respectively. Creativity in science leads to building of scientific infrastructure (Moravcsik, 1981), development of problem solvers (Taddei & Sasco, 2011), industrialization of a country (Yoong, 1986, GOK, 2007) and self-actualization (Maslow 1987). Dawson, Andrea, Affinito and Westby (1999) argue that creativity is a major educational goal and hence education policy documents need to raise awareness on benefits of creativity especially to teachers who are to encourage its development in their learners. However, Shaheen (2010) argues that developing countries have ignored creativity and yet there is need to integrate creative thinking skills in education in order to shape future orientation and actualizing reforms in political, economic and cultural areas (Oral, 2006).

Majority of biology teachers (99%) felt that they had a role to play in enhancing learners' creativity. However, fewer teachers could explain the reason for their response. Fourteen point six percent (14.6%) of teachers noted that the teacher provides an environment for learners to express creativity, 31.2% thought of teachers acting, as guide while 4.4% thought of teachers as being role models. According to Liu and Lin (2013), Simonton (1999) teachers are mentors and role models in promoting creativity in their learners. Teachers should also provide an environment that promotes creativity by acting as enablers of the learning process and arranging conditions of learning appropriately (Validya, 2003; Torrance, 1998; Davis, Digby, Jindad-snape and Howe, 2014). According to Andiliou and Murphy (2010), Cropley (2015), Saracho (2012), Liu and Lin (2013) and Konstantinidou, Gregoriadis, Grammatikopoulos and Michalopoulou (2013), the role of the teacher in enhancing creativity is to nurture and support learners' creative potential.

The results indicate that 61% of biology teachers' thought they include classroom practices that encourage development of scientific creativity during their lessons. However only 47.5% of teachers thought that they allow learners to criticize experimental procedures (M=1.90). However, during lesson observations of teachers who had the highest mean on classroom practices, discrepancy was noted between what they said they do and what actually occurs during their lessons. Most of the activities that do encourage scientific creativity initiated by teachers were mainly on recognition of relationships and flexibility. Very few activities initiated by teacher were on sensitivity and planning and yet practical activities are an integral part in science teaching. Practical activities provide learners with opportunities to think and act like real problem solving scientists. Henriksen, Creely and Henderson. (2019) points to the issue of teachers being expected to encourage creativity in their learners yet the school curriculum does not provide guidance on how to distinguish it from other capabilities or how to achieve it.

For activities initiated by learners, most were also on recognition of relationship and flexibility. Activities on sensitivity were mainly on identification of sources of errors on what other learners had responded to either teachers' questions or teachers' statements. Learners initiated no activity on planning but only one activity on planning was initiated by one

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teacher once. The findings are in agreement with Mansour's (2013) work who found consistency between teachers' traditional pedagogical beliefs pedagogical beliefs and their practices but inconsistency between teachers' constructivist beliefs and their practice. A survey of teachers in Europe on how they perceive and understand creativity, and how they foster creativity through their teaching found discrepancy between how teachers perceive creativity and the way they claim to foster it during their teaching (Cachia & Ferrari, 2010). They concluded that teachers' opinion on creativity in education is stronger than their practices. Schacter, Thum and Zikfin (2006) observed elementary teachers over a multiple of lessons and found that only a few used strategies that supported creativity. This discrepancy between what teachers think are the activities that encourage creativity and what actually occurs in a lesson could be attributed to the fact that their conceptualization of creativity in the classroom context is poor. According to Fasko (2010), teachers' ability to foster creativity depends on the kind of training they received. Therefore, the kind of training biology teachers got could have been deficient of knowledge and skills on classroom practices that enhance creativity in their learners. A Study by Anditi (2007), found that teachers dominated their chemistry lessons. Most of their questions focused more on recall of facts in chemistry while question that require learners to reformulate scientific statements or evaluation of experimental procedures were lacking. The same trend was observed in the observed Biology lessons. Haigh (2007) notes that questioning skills by teachers are important in that they lead to new possibilities hence enhancing creativity. According to Mc Farlane (2013) science education should re-orient the teaching learning practices to focus on science as "an art" of acquiring scientific knowledge rather than as an inflexible process of knowing about the environment

CONCLUSION AND RECOMMENDATIONS

Secondary school biology teachers believed that they include classroom practices that inculcate scientific creativity in their learners during their lessons. However, what occurs during biology lessons was less than what they claimed to offer. This indicates a discrepancy between what they believe to be taking place during their lessons and what really takes place during the lessons. This suggests that teachers have limited understanding of classroom practices that enhance scientific creativity in their learners, however, this can be improved if their conceptualization in the classroom context is improved. This shows that there is a need for continuous in-service training of biology teachers, what is also referred to as continuous professional development (CPD) to sensitize them on specific instructional methods and activities that can be used to enhance scientific creativity in their learners.

In view of the above conclusions science teacher education programmes need emphasize the necessity to sensitize teachers on the importance of scientific creativity, and how to inculcate it in learners. Teacher education programmes should further provide teacher trainees with the theoretical basis of the activities that would encourage learners to develop their scientific creativity skills. Curriculum developers should prepare more curriculum materials for both teachers and learners that include more classroom activities that inculcate scientific creativity. National examinations should include more test items that measure scientific creativity in learners since the nature of items in national examinations dictate the kind of activities teachers engage their learners in.

REFERENCES

[1]. Adzliana, M. D., Omar, J., Turiman, P. & Osman, K. (2012). Creativity in Science Education. *Procedia - Social and Behavioral Sciences 59,* 467 – 474.

[2]. Aljughaiman, A. & Mowrer, R. E. (2005). Teachers' conception of creative and creative students. *Journal of Creative Behavior, 39(1)* 17-34.

[3]. Andiliou, A. & Murphy, P. K. (2010). Examining valuations among researchers and teachers conceptualizalation of creativity. A review and synthesis of contemporary research. *Educational Research Review, 5(2010)201-219.* Retrieved September 9, 2011, from *www.elsevier.com/locate/EDUREV.*(doi:101016/j.edurev.2010.07.003.

[4]. Anditi, Z.O. (2007). *Effect of Learner and School Characteristics on the Attainment of Secondary School Chemistry Students in the Cognitive Science Process Skills of Evaluation, in Rift Valley Province, Kenya.* Unpublished PhD Thesis. Egerton University.

[5]. Alsahou, H. (2015). *Teachers' beliefs about creativity and practices for fostering creativity in science classrooms in the state of Kuwait.* Doctoral Dissertation submitted to the University of Exeter (United Kingdom). Retrieved on 24/03/2020 from *https://ore.exeter.ac.uk/repository/bitstream/handle/10871/19224/AlsahouH.pdf?sequence=1&isAllowed=y*

[6]. Beghetto, R. A. (2007). Does creativity have a place in classroom discussions? Teacher responses preferences. *Thinking Skills and Creativity, 2 (I),* 1-9.

[7]. Beghetto, R. A. & Plucker, J. A. (2006). The relationship among schooling, learning and creativity: "All roads lead to creativity "or you can't get there from here"? In J.C. Kaufman and J. Baer (Eds.). *Creativity and Reason in Cognitive Development*, New York: Cambridge University Press.

[8]. Bereczki, E.O., Kárpáti, A. (2017). Teachers' beliefs about creativity and its nurture: A systematic review of the recent research literature, *Educational Research Review.* doi: 10.1016/j.edurev.2017.10.003.

[9]. Bjorner, T. & Kofoed, L. S. (2013). How academic teachers perceive and facilitate creativity. *European journal of Engineering Education, 38(5):* 556-566, *DOI : 10.10803043797.2013.82441.*

[10]. Cachia, R. & Ferrari, A. (2010). Creativity in schools: A survey of teachers in Europe. *JRC Scientific and Technical Reports.* Online at http://www.jrc.ec.europa.eu

[11]. Craft, A. (2010). *Creativity and Education Futures: Learning in a Digital Age*. Stoke on Trent:Trentham Books.

[12]. Cramond, B. (2001). Fostering creative thinking. In F.A Karnes & S.M Bean (Eds.), *Methods and Materials for Teaching the Gifted, (Pp 399-444)*. Waco TX. Prufrock Press.

[13]. Cremin, T. (2009). Creative Teachers and Creative Teaching. In Wilson, A. (Ed.), *Creativity in Primary Education* (2nd ed., pp. 36–46). Achieving QTS Cross-Curricular Strand. Exeter: Learning Matters

[14]. Cropley, D. H. (2015). Fighting the Slump: A multifaceted exercise for Fostering Creativity in Children. *The International Journal of Creativity and Problem Solving 24(2).*pp 7-22.

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ISSN: 2186-8492, ISSN: 2186-8484 Print
www.ajssh. leena-luna.co.jp

[15]. Cropely, A.J. (2001). C*reativity in Each and Learning a Guide for Teachers and Educators*. Sterling VA; Stylus Publishing.

[16]. Davis, D., Digby, R., Jindae-snape, D. & Howe, A. (2014). The Role and Development Needs of Teachers to Promote Creativity. A Systematic Review of Literature. *Teaching and Teacher Education, 41,* 34-41.

[17]. Dawson, V.L., D'Andrea, T., Affinito, R. & Westby, E. L. (1999). Predicting creative behavior.

[18]. A Re-examination of the divergence between traditional and not traditional teaching. *Creativity Research Journal*, *12*, 57 – 66.

[19]. Ee, J., Tan, O. S. & Ng, A. (2007). Styles of creativity. Adapters of innovation in a Singapore Context. *Asian Pacific Education Review 8 (3),* 364-373.

[20]. Falconer, E. G., Cropley, D. H., and Dollard, M. F. (2018). An Exploration of Creativity in Primary School Children, *International Journal of Creativity and Problem Solving, 28*:*2*, pp. 7-25.

[21]. Fasko, D. (2010). Education and Creativity. *Creativity Research Journal, 13(3)317-327.* DOI: 10.1207/S15326934CRJ1334-09

[22]. Gall, M.D., Gall, J.P. & Borg, W.R (2003). *Educational Research: An introduction (7th Edition)* Pearson Education Inc.

[23]. Gibson, R. (2010). The 'Art' of Creative Teaching: Implications for Higher Education. *Teaching in Higher Education 15*(5): 607-613.

[24]. Government of Kenya (2007), *Kenya Vision 2030. A Globally Competitive and Prosperous Kenya.* Nairobi. Government Printers.

[25]. Gupta, P. & Sharma, Y. (2019). *Nurturing Scientific creativity in the Classroom.* DOI: https://doi.org/10.1007/s12045-019-0810-8 Retrieved from *https://www.ias.ac.in/article/fulltext/reso/024/05/0561-0574* on 24/03/2019.

[26]. Haigh, M. A. (2007). Can investigative practical work in high school biology foster creativity? *Research in Science Education, 37*, 123-140. *https://doi.org/10.1007/s11165-006-9018-5*

[27]. Hayrynen, Y. P. (2009). Creation in science, art and everyday life: ideas on creativity and its

[28]. varying conceptions. In E. Villalba (Ed.), *Measuring creativity: Proceedings for the conference 'Can creativity be measured?'* (pp. 279-301). Brussels, Luxembourg.

[29]. Henriksen, D. , Creely, E. & Henderson, M. (2019). Failing in Creativity: The Problem of Policy and Practice in Australia and the United States. *Kappa Delta Pi Record, 55:1, 4-10,* DOI: 10.1080/00228958.2019.1549429

[30]. Hu, W. & Adey, P. (2002). A Scientific Creativity Test for Secondary School Students. *International Journal of Science education, Vol. 24(4)389-403.* Retrieved June 24, 2011, from *DOI:10.1080/09500690110098912.*

[31]. Hu. Sui. Han, Wang & Adey (2010). Creative Scientific Problem Finding and Its Developmental Trend. *Creativity Research Journal 22(1):46-52*. DOI: 10.1080/10400410903579551

[32]. Kind, P. M. & Kind, V. (2007). Creativity in science education: Perspectives and challenges for developing school science. *Studies in Science Education*, *43*:1–37.

[33]. Konstantinidou, E., Gregoriadis, A., Grammatikopoulos, V., & Michalopoulou, M. (2013). Primary physical education perspective on creativity: the nature of creativity and creativity fostering classroom environment. *Early Child Development and Care (2013) DOI: 10.1080/03004430.2013.818989.*

[34]. Koul, L.K (1993). *Methodology of Educational Research*. Vikas publishing Hse pvt ltd.

[35]. Liang, J. C. (2002). *Exploring Scientific Creativity and Eleventh Grade Students* in Taiwan. Retrieved June 10, 2011, from http://adsabs.havard.edu.abs/2002PhD...1826.

[36]. Liu, S. & Lin, H. (2013). Primary teachers' beliefs' about scientific creativity in the classroom context. *International Journal of Science Education*, DOI:10.1080/09500693.2013.868619.

[37]. Maslow, A. H. (1987). *The Farther Reaches of Human Nature*: Viking Press

[38]. Maundu, J. N., Sambili, H. J., & Muthwii, S. M. (1998). *Biology Education: A Methodological Approach.* Lectern Publications ltd.

[39]. Mansour, N. (2013). Consistence and inconsistence between science teachers' beliefs and practices. *International Journal of Science Edition, 35:7, 1230-1275, DOI: 10.1080/09500693.2012.743196.*

[40]. M C Farlane, D. (2013). Understanding the challenges of science education in the 21st century: New opportunities for scientific Literacy. *International Letters of Social and Humanistic Sciences, 4: 35-44.* Online at www.ilshs.pl

[41]. Moravcsik, M. J. (1981). Creativity in science education. *Science Education, 65, 221-227*

[42]. National Education Association (2010). *Preparing 21st Century Students for a Global Society: An Educator's Guide to the "Four Cs"*. Retrieved on 24/03/2020 from *http://www.nea.org/assets/docs/A-Guide-to-Four-Cs.pdf.*

[43]. Newton, D.P. and Newton, L.D. (2009b). What teachers see as creative incidents in elementary Science lessons. *International Journal of Science Education DOI:10.1080/09500690903233249.* Retrieved July 10, 2019.

[44]. Okere, M.I.O. (1986). *Creativity in Physics Education,* Unpublished PhD Thesis, University of London.

[45]. Oral, G. (2006). Creativity of Turkish prospective teachers. *Creativity Research Journal, Vol. 18,* pp 65-73. *DOI: 10.1207/s15326934crj1801=8*

[46]. Plucker, J. A, Beghetto, R. A. & Dow, G. T. (2004). Why isn't creativity more important to Educational psychologists? Potential, pitfalls and future directions in creativity research *Educational Psychologist, 39,* 83-92.

[47]. Saracho, O. (2012). Creativity theories and related teachers beliefs. E*arly Child Development and Care, Vol.183 (35-44) DOI: 10.1080/03004430.2010.535899*

[48]. Schacter, J., Thum, Y.M. & Zikfin, D. (2006). How much does creative teaching enhance elementary school students' achievement? *Journal of Creative Behavior, 40,* 47-72

Leena and Luna International, Chikusei, Japan.
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ISSN: 2186-8492, ISSN: 2186-8484 Print
www.ajssh. leena-luna.co.jp

[49]. Seltzer, T. & Bentley, K. (1999). *The Creative Age: Knowledge and Skills for the New Economy.* Demos,London. Retrieved June 6, 2011, from *http://www.amazon.com/creative-Age- Knowledge-skills-Economy/df/1898309701.*

[50]. Shaheen, R. (2010). Creativity and Education. *Creative Education Vol. 1(3), 166-169.DO1: 10.4236/ce.2010.13026.*

[51]. Siew, N. M. & Chin, M. K. (2018). Design, Development and Evaluation of a Problem-Based with Cooperative Module on Scientific Creativity of Pre-Schoolers. *Journal of Baltic science Education. Vol.17 (2)* P. 215-228

[52]. Simonton, D. K. (1999). O*rigins of Genius: Darwinian Perspectives of Creativity*. New York: Oxford up.

[53]. Sternberg, R. J. (2003). Creative Thinking in the Classroom. *Scandinavian Journal of Educational Research, 47 (3),* 325-338.

[54]. Sternberg, R. J. & Lubert, T.I. (1999). The Concept of Creativity: Prospects & Paradigms. In Sternberg R.J (Ed), *Handbook of Creativity* University Press.

[55]. Taddei, F. & Sasco, L. R. (2011). *Proposing Measures to Promote the Education of Creature and Collaborating Knowledge Builders.* Retrieved June 13, 2011, from *http://ec.europa.au/edu/life-long-learning-policy/doc/creativityreport/edn.pdf.*

[56]. Torrance, E. P. (1998). *The Torrance Tests of Creative Thinking Norms, Technical Manual Figural (streamlined) Forms A & B*. Bensenville, IL: scholastic testing service Inc

[57]. Validya, N. (2003). *Science Teaching for the 21st century*: New Delhi, Deep and Deep Publications PVT Ltd.

[58]. Wiersma, W. & Jurs, S. G. (2005). *Research Methods in Education. An introduction* (8thEd.). Pearson Education Inc.

[59]. Yoong, C.S. (1986). Making science and technology education relevant to youth. In commonwealth secretariat. *Making Science, Technology and Mathematics Education Relevant.* Report on the sixth biennial Asia regional workshop. Institute of education Singapore. Commonwealth secretariat.