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Teaching Science In Rural Communities

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Abstract: ***Though the achievement of pupils in Science is generally poor, pupils in rural communities have relatively poorer achievements in science. Pupils in rural communities do not enjoy the best of facilities and amenities that support the learning of science, relative to their counterpart in urban communities. However, the pupils in rural communities can enjoy science lessons, if in spite of poor infrastructure, shortages of teachers, and inadequate teaching and learning materials, available science teachers depend on pupils' pre-conceptions, allow pupils to dictate the direction and pace of science lessons, and always engage pupils in activities, such that the learning of science is fun.***

Keywords: Teaching, Science, Rural, Communities

I. INTRODUCTION

School going children residing in villages and small remote towns, here in called rural communities, are disadvantaged socially, economically and educationally as compared to their counterparts in cities. As established, pass rates in these communities are much lower than their counter parts in urban areas (Byun, Meece, & Irvin, 2012; Shadreck, 2012). The situation regarding science education is worse, especially in sub-Saharan Africa and in developing country in general, and this raises so much concern for science educationists in these areas. Pupils in rural communities too deserve to know and use science and technology in their daily lives. They deserve a good understanding of natural phenomena like rainbow and rainfall so they can break away from the myths they may be holding about such phenomena. They will be left far behind in science if we keep providing them with some 'hard-to-comprehend' science education. As noted by Lingham (2012), already their counterparts in urban areas are doing relatively better. Though the environment in rural communities do not sometimes promote quality science education, if science educationists make conscientious effort, they can bridge the science education gab between the rural and urban communities.

When schools in urban communities do not perform well in science, it becomes an issue; however, the continual poor performance of pupils from rural communities is seen as no news. It is no news because somehow we have come to accept as a fact that pupils from rural communities cannot do well just because they are live in rural communities. We, I mean, science educationists and the public at large, know that the rural urban divide is limiting the potentials of the rural pupil and yet we do very little to help. All we do is to pick the promising children in rural areas and send them to cities and big towns in order for them to receive 'good education'. What happens to the average and the weak pupils who need our attention most? Something can be done to help science education in rural communities so as to lift the image of science education in these areas and whip the interest of pupils from rural communities to apply science in their daily lives and for those who are able to progress to higher levels, to pursue science related courses. Acknowledging that the rural-urban school divide exits, is a step in getting the rural pupils get quality science education that matches what the urban pupils receives, and this essay will suggest practical ways achieving this.

In this article I will attempt to outline a number of things that can be done in order for the rural pupils to receive quality science education. But before that, I will look at the characteristics of schools in rural communities and how they affect science teaching and learning. This will provide a background to the nature of schools in rural settings and share what I think exist or does not exist in rural schools as well as difficulties pupils in these school face. I will then briefly discuss the needs of the rural school pupils. This will be the basis for pointing out what science teachers in rural schools

can do to help their pupils. I will suggest a number of teaching techniques and strategies that can help the science teacher, in spite of all the challenges he/she faces, to guide pupils to learn science in a practical and meaningful manner.

II. CHARACTERISTICS OF RURAL SCHOOLS

Characteristics of rural schools may vary across nations and regions, however irrespective of geographical location rural schools, most rural schools have small class size, relatively poor infrastructure, and insufficient science teachers. As I have already mention these characteristics may differ from country to country and with a particular country they may differ from one region to another. In developed countries where supplies of teaching and learning materials is good, rural schools are likely to have about the same supplies as their counterpart in urban areas. In such places, the rural schools may even have more stock of materials than the urban schools because non-use of material due to the small class size or lack of teachers to use them, unless supplies are tied to school population. The rural schools usually have low enrollment because they serve communities that are not densely populated. This may not be so for rural schools located in some remote part of Africa. Ghanaian rural schools, for example, do not serve only one community. One school located in a farming community, serves several villages and huts located in about three-kilometer radius. Such schools though are located in communities of less than one hundred people can have a single teacher teaching a class of about sixty pupils. Most rural schools do not have enough teachers to teach all classes, and all subjects in cases where subject teachers are required (Hudson & Hudson, 2008). This may not be the case for countries like Japan, where teachers are in excess, where the teaching profession is lucrative and where there are huge incentives for rural teachers. In spite of the generally small class sizes, poor staffing, inadequate materials and poor infrastructure remain the most striking characteristics of rural schools.

Rural schools generally do not have over populated classes. Two reasons which can be considered region dependent accounts for class sizes. Let me first deal with the situation with a typical rural African school before I look at the situation with to respect a rural school situated in a developed country. A typical rural African school is located at the outskirt of a small community whose population is predominantly engaged in some kind of agriculture activity. The population may generally be crop farmers or fishermen and fish mongers whose trade had been passed on from past generations and hope to pass on their profession to the current and generations unborn. In such communities, the primary aim of sending pupils to school is to enable the pupils attain basic education, be able to write and do basic arithmetic. The communities do not look at education beyond basic education and so do not attach so much importance to the education of their wards. In such places class sizes are low because there is high pupil absenteeism or dropout and not necessarily because communities are not densely populated (Lamb, Glover & Walstab, 2014). I am not saying population is not a factor at all. In areas where the schools serve fewer communities of small population size, class sizes will also be small. In developed countries, the major factor that accounts for small class sizes is the population of the community in which the school is situated. If the population of school going children in a community is high, then the class size will also be high. For most rural communities in developed areas, the population of children of school going age is small and as such the class size is also small. Rural schools, whether in a developed or developing country have small class sizes and so are the resources (Lamb, Glover & Walstab, 2014).

Rural schools have relatively poor infrastructure. While urban schools have good and strong building with staff rooms, computer laboratory with internet connectivity, science laboratory, connection to the national electricity grid, good wash rooms and well managed play grounds, the rural counterpart may have a single structure with a small grassed spaced as their playground. This situation may not be so pronounced in developed countries but the part of the globe where I live, many rural schools have buildings without windows and electricity as their classroom. Currently Ghana government is making efforts to improve structures serving as classrooms for children in rural communities, however school buildings in rural communities are generally poor. You will hardly find a school that has a space to serve as a science laboratory or computer laboratory. As for electricity and internet connectivity, I need not mention, since the communities either do not have communication network service or, as Howley, Wood & Hough (2011) noted, have very poor services. The situation with electricity supply has been improving in rural communities; however, in community where electric power is available, the schools do not have electricity connection. While computers are absent in many rural schools in, Ghana, for example, the schools that have them do not have electricity to power them. In rural Africa, schools do not just lack good buildings, they also lack social amenities, such electricity and internet connectivity.

The 'harsh' conditions in rural communities in general make teachers refuse postings to such places or seek transfer to urban area and so many schools in rural communities are under staffed (Barley & Brigham, 2008). Teachers would prefer to work in urban communities where access to water, electricity, communication services and housing are good. Many rural communities as mentioned above lack these basic amenities and so are not attractive to teachers. The second reason has not been empirically established but the perception is there. The second reason is that teachers would want to work in areas where school climate promotes learning, and where the learners appear to be academically good. This good school climate does not exist in most schools in rural communities. Every teacher would want his/her efforts to yield positive results. Positive results here mean, the learners make efforts to and actually grasp the concept the teacher wants them to grasp. In cases where the teacher tries a variety of methods in helping the learners understand a concept, and yet the pupils will still be far from understanding him/her, the teacher becomes dejected. Besides this feeling, many teachers in the rural communities may either teach multiple classes or subjects they did not major in (Harmon, Gordanier, Henry & George, 2007). It is perceived that such conditions exist in most rural schools and so many teachers would want avoid

rural schools. Teachers would for these reasons prefer to work in urban schools than in rural schools. The effects of this, according to Goodpaster, Adedokun & Weaver (2012) are that staff of rural schools are mostly new and inexperienced and quality of education in such schools are generally low.

Other than the small class size, inadequate staff and relatively poor infrastructure put the rural school pupil at a disadvantage. The learning conditions are generally not good as compared to the urban schools since the rural schools have poor infrastructure. While the urban school pupils sit behind a computer to take ICT classes, the rural pupil might not even see one. Due to inadequate staff, the rural school may not get trained science teachers to teach them. In most cases, teachers teach subjects they did not major, because science teachers are not available (Eppley, 2009). Due to the characteristics of rural schools discussed, the pupils in the rural schools do not get their learning needs met.

III. LEARNING NEEDS OF PUPILS IN RURAL COMMUNITIES

Pupils in rural schools just like their counterpart in urban schools are expected to gain basic scientific knowledge that will be helpful as they progress to higher levels of education, understand and be able to explain some natural phenomena scientifically, have the ability to carefully analyze situation and events, work collaboratively with others and gain confidence in reporting. Though this list may not be exhaustive, these in my view represent the fundamental needs of rural school pupils, irrespective of location or their aspirations. The rural pupil is in school to gain knowledge including, scientific knowledge and apply the knowledge gained in his or her daily life as he/she tries to make meaning from the phenomena he/she sees in nature. Socially, he/she is expected to work collaboratively with his/her peers and present to them ideas he/she has. I would like to briefly touch on each of these needs before I delve into how these needs can be met by science teachers in rural schools.

We all school so as to gain knowledge that is worthwhile. Gaining knowledge that will enable the learner to read, write, and contribute something to the advancement of society is the prime need of the rural pupil who has come to sit in a classroom to be educated. Many children in rural areas are not able to attain higher education. But this does not mean they are not able to contribute to the advancement of society. In their trade they are able to make a difference owing to the knowledge they gain in school. Knowledge in science is essential for everyone in today's scientific world, because one way or the other, scientific knowledge will be applied in wherever one is. The science teacher should see this as a need of the rural school pupil.

Ensuring that the pupil has the knowledge is not enough, he/she must be able to apply the knowledge. I always say that there is no difference between the one who has the knowledge and cannot use it and the one who does not have the knowledge at all. Acquired knowledge must be put to use, and this will depend on how the knowledge was acquired by the learner. If the science teacher's emphasis was on getting the pupil to only pass exams, it will no longer be useful after the exams, but if the science teacher presents knowledge in situation that the knowledge is used, the pupil will also be able to apply it where necessary. The pupil needs to know how to apply the basic scientific knowledge he/she learns so that in case he/she does not continue to school he/she will still find the knowledge gained worthwhile.

The rural pupil need to learn the skill of working effectively with his/her peers and present his/her ideas to his/her colleagues. This need of the learner is normally not considered while science teachers are teaching and so science teachers sometimes produce good science pupils who are social misfits. Letting learner work in groups, interact with materials, discuss ideas with his/her colleagues, listen to the views of others and finally, present the ideas of the group to the hearing of the entire class, builds the confidence to interact socially with people in and out of school, and co-exists peacefully with them. This is a need that is overlooked by many science teachers, just because it will not be examined. What we must bear in mind is that the pupil after school must be able to work collaboratively and peacefully with others and must be able to accurately report ideas to the people he/she interacts with.

The needs of the rural school pupil are just like that of the urban school pupil. They both need to acquire scientific knowledge, apply scientific knowledge, learn to work cooperatively with others and clearly report ideas to others. These are the elements that when acquired makes the rural science pupils a good science pupil. Rural science teachers have the task is to find and use techniques that help the rural pupil acquire scientific knowledge and skills that will make the rural school pupil functional in society, even if the pupil's education terminate with basic education.

IV. TECHNIQUES THAT WORK

Meeting the needs of the rural school pupils in many schools require a shift in teaching technique and assumptions about the abilities of the rural school pupil. The traditional teaching methods where the teacher imposes his ideas on the pupils makes, in my view, the rural school pupil see schooling as a burden. It also makes the pupil depend so much on the teacher that he/she see himself or herself as someone who does not know so much and must always go to others before he/she can understand something. The pupil grows up to become someone who cannot act independently. Making the pupil love science lessons and schooling in general calls for a departure from the old ways of teaching to one in which the teacher depends on what the pupil knows, lets the pupil have the loudest voice, encourages group work, and makes use of local resources.

A. DEPEND ON WHAT THE PUPILS KNOW

The science teacher should as much as possible rely of what the pupil knows already, not only during the introductory stage but throughout the lesson. Science teachers often limit the review of relevant previous knowledge to the introduction of the lesson and assume that the pupil has no knowledge about the 'new concepts' he/she is teaching. This puts the

teacher in the traditional role in which the teacher is seen as 'know all' and so must 'say all'. It is this assumption that makes some science teachers have serious difficulties engaging pupils in discussions. The difficulties arise because the questions to initiate and sustain the discussions are not based on the pupils' pre-conceptions about the concept under discussion. Science lessons are seen as boring because pupils cannot make any connection with what they already know and as a result they would not make any meaning from what the teacher would be saying. Pupils, no matter their age and social background, come to class with a good store of knowledge that is useful in science lessons.

For almost every science topic, there is something the pupils know that can be useful to the 'new thing' the pupil is learning (Antoniadou & Skoumios 2013). The pupils do some science practical and apply some scientific principles and concepts outside the school unknowingly. These may be unrefined and the task of the science teacher is to help the pupils refine them. For instance, the pupils know that when water is heated, the water begins to evaporate as it warms up and continues to evaporate as it boils. The pupils know that when left to boil for a long time, the water will evaporate and the pot will be empty. The pupils also know that the heat the water receives comes from the source of heat being used. While teaching the concept evaporation, the teacher need not just start by reviewing what the pupils know about heating water and end it there. Beside a scientific and an explanation at the molecular level, the pupils already know all about evaporation. The science teacher can make the lesson real to the pupils by relaying on the pupils' knowledge from their water boiling experience. Science teachers acknowledge that there is a previous knowledge, what I like to call pre-conception, but it is used only at the time the concept to be learnt is being introduced.

Once the pre-conception is reviewed at the start of the lesson, it is assumed that the pupils do not have any other pre-conception related to the concepts that follow. It is assumed, rather erroneously that the *'new concepts*' are new to the pupils and so it must be presented to the pupils for their consumption. This to me is the bane of poor performance of children in science. If each way along the line science teachers would depend on the pre-concept of pupils, science teaching and learning would be enjoyable by both the teacher and learner and the learner invariable would understand the science we teach them.

When the pre-conceptions of pupils are ignored, meaningful classroom discussion is hampered. To be able to have good discussions with pupils, the concepts around which the discussion is centered should not necessarily be known to the pupils, however the questions that would initiate and sustain the discussion should be based on the pre-conceptions of the pupils. The pupils would not be able to contribute in the discussions if they have no idea about the concepts. This does not mean that pupils cannot be engaged in discussion centered on some abstract concepts the pupils have very little knowledge about. In such cases the discussions can be initiated and sustained by relying on some ideas the pupils have. For example, in discussing digestion we can rely on the parts of the body, eating, defecating, the process of grinding seeds and nuts, how corn mill works, when the pupils are familiar with it, the science teacher adds the action of enzymes and the end product of digestion. When there is something the pupil can link the new thing to, learning is almost always meaningful.

Depending on pupils' pre-conception is helpful. It creates an atmosphere that makes, the even, new concepts real to pupils. The pupils can comprehend what is been taught because throughout the lesson they able to generate their own conception relating to the concepts being taught by linking the new concept to their pre-conceptions. In classroom where the teacher relies on pupils' pre-conception, the pupils are able to partake in discussion and the teacher does less work in letting pupils understand 'new concepts'. Rural science teachers therefore must make conscious efforts in using pupils' pre-conceptions.

B. LET THE PUPILS RULE THE CLASS

The rural school pupil is the one who is desiring scientific knowledge, skills and attitudes, he/she must therefore be listened to and also be allowed to control the pace and direction of classroom activities with his/her ideas and questions. In traditional classrooms where characteristics of behaviorism dominate, the teacher imposes his ideas on the pupils and 'forces' the pupils to learn at a pace determined by the teacher. The teacher takes this role because the pupils in such a classroom are considered empty vessel waiting to be filled. And it appears to me that in such classrooms the 'skillful' teacher is the one who appears to be filling the minds of the pupils with ideas. This 'skillful' teacher becomes dejected if the pupils are not able to reproduce or re-model the concepts in the form they were given and complains that the rural pupils are weak and that their training is a difficult task. If science teachers really want to see how good the rural pupils are, the pupils must be allowed to control the class with their ideas and questions. In such instances the teacher becomes a mere facilitator, ensuring that erroneous ideas are not upheld in the classroom (Khalid, & Azeem, 2012).

Allowing the pupils to rule the class with their ideas, means, giving the pupils room to express their opinion on a given concept and always creating conditions that will allow the pupils to construct their own knowledge. In many instances the ideas move from teacher to pupils. Such conditions do not allow the pupils to express their views for the teacher to know the intelligent ideas his/her pupils have. Allowing the pupil to rule the class goes beyond depending on what the pupils already know. It involves developing activities to suite the developmental and intellectual levels of the class and then giving pupils listening ears. It also has to do with ensuring that the pupils' needs are considered the most important. Where the teacher finds that, the pupils need a particular conception which is not captured in his/her lesson notes, he/she should abandon the notes and give remedial teaching before continuing. The teacher must see the pupils as the most important factor in his work - listen to and be ready to make sacrifices that will help the pupils understand concepts better.

Where the pupil rules, there is space and freedom to ask questions and answer question without fear of being rejected or ridiculed by teacher nor peer. Teachers tend to see what

misconceptions or erroneous answers are there to be corrected only when they allow their pupils to contribute ideas in class or ask questions. By engaging pupils in class discussions, creating opportunities such as reporting, and brainstorming, teachers make them feel their ideas are important and the pupils develop a mindset that they also have ideas that are relevant in class. When teachers allow pupils to ask questions and pupils' questions are addressed promptly, they take that as opportunities to clear their doubts about a particular concept. In classrooms where pupils are allowed and giving the opportunity to ask questions, even ones that challenge ideas the teacher has presented, pupils tend to learn better and faster.

As already mentioned, the one who is learning is the pupil not the teacher. The pupils' needs, questions and ideas must therefore be taken as the important things in the classroom. The teacher can do this by creating a friendly atmosphere that lets the pupils feel their ideas and questions are needed in every science lesson. The teacher can do this very effectively, if he/she takes on the role of a facilitator and uses the needs, the ideas and questions of the pupils to drive his/her lessons, at a pace comfortable to all the pupils in class.

C. MORE ACTIVITIES LESS TALK

Children by nature are playful and would not find learning drudgery if science teachers engage them in activities. The activity method of teaching science is the principal approach to use if the teacher wants to reduce his talking and allow the pupils to playfully learn science. The method requires that the teacher engages pupils in activities that will help the pupils grasp some concepts. The activities may come in the form of experimentations, studying diagrams and group discussions. Engaging pupils in pair or group activities lead the pupils into learning to collaboratively work with colleagues, learn to respect the views of others, put across ideas and defend those ideas and report ideas.

The best way of ensuring that pupils do some hands on activities is to employ the 'activity method' of teaching science. The teacher provides a set of materials to the pupils and guides them to experiment either by verbally instructing them to do something or by providing them with worksheet to follow and perform the activities individually, in pairs or in groups, when there are insufficient materials. When pupils are done with the activity, the teacher either asks them to report observation and then use the observation to lead the pupils to the desired concept or directly discuss the pupils' observations and lead the pupils to discover the concepts themselves. In the activity method pupils can also be put into groups and given a task to discuss or analyze and report on. Though these two are not normally employed in science lessons they form part of the activity method since there is an activity pupil will have to perform.

Pupils easily understand and retain concepts learnt through activities. By performing the activities, the pupils see the practical nature of science and can always connect the concept with the activity they have performed. Pupils who perform an experiment to show that different metals conduct heat at different rate would hardly say that all metals conduct heat at the same rate. The one who through experimentation has established that copper conducts heat better than iron will hardly say the opposite when asked. The one who has used water and mirror to create rainbow would hardly say 'rainbow can grow into the soil'. Also pupils who have discussed the water cycle in a group, generated their own model of water cycle (acceptable though) and presented to class will not easily forget the water cycle. Though the teacher might have said very little, the pupils will retain a lot of the concepts, because the pupils generated their own conceptions in a manner they can easily retrieve.

Pupils learn to communicate ideas, tolerate the ideas of others and learn the skill of reporting when they are engaged in activities, most especially, where they work in groups. The groups are usually mixed; boys and girls, different races, different ethnic groups and different abilities. The heterogeneity of the groups permits members of the groups to share ideas, dismiss, reconstruct and accepts views of others in a peaceful manner. They learn to collaborate with each other. The weak as well as the good pupil will deliberate on what the group must report and what it should not. Usually in groups, suggestions are defended by those who propose them. This enable the pupils to communicate and defend their ideas. During reporting, the pupils learn the skill of standing before audience to read reports.

Where supply of teaching and learning materials is inadequate, or are not available, the science teacher's resourcefulness is put to test. For most science topics, it is possible to improvise materials. Improvisation has its own challenges. Improvised materials, for example, often do not give accurate results. In spite of this challenge, it is better to use improvised materials than not using anything at all. Where materials are not available and the teacher alone cannot provide all the material the teacher can use, he/she can ask the pupils to bring some from home, where possible. For example, the teacher can ask pupils bring uprooted plants of different kinds or bring empty cans and boxes to school. This practice is common in rural Africa where teaching resources are very scarce. Science teachers teaching in areas where teaching and learning materials are inadequate must be resourceful and committed to meeting the needs of their pupils.

When the teacher talks less but give more activities to the pupils and use the activities to help pupils form their own ideas about concepts, the pupils tend to learn better. The use of activities reduces the teachers 'talk time' and also makes the pupils see scientific concepts in action. They see science as a practical subject and not a difficult abstract subject. Applying scientific concept therefore becomes very easy for the pupils. The pupils who learn science through activities and group work also learn the skills of reporting, putting across ideas and defending ideas.

V. CONCLUSION

Schools in rural communities have characteristics that make both teachers and pupils face difficulties in their teaching and learning respectively. Rural schools have poor infrastructure and they are also usually understaffed. Rural school as compared to urban school usually do not have decent classroom and classroom facility may either be poor or absent. In rural Africa for example, pupils in rural

communities may have to share chairs and tables. The situation is the same for teaching and learning materials. Many rural schools do not have enough teaching and learning materials such as science laboratory equipment and computers and their accessories. Besides the materials, rural schools are also understaffed. This forces many teachers to teach multiple classes and or subjects outside their major. These negative conditions make the rural schools unattractive to teachers and so many teachers tend to leave the rural communities few years after being there.

Pupils in rural communities have needs; gain basic scientific knowledge that will enable pupils to use the knowledge explain some natural phenomena, be able to analyze situations and events, be able to work with others and gain reporting skills. The rural science teachers' task is to organize the classroom and classroom activities such that these needs can be met. I have suggested three strategies that will make it easy for the rural science teacher to help pupils learn science in a meaningful, collaborative and practical way. The science teacher should not assume the pupils have no prior knowledge related to the topic being taught, rather he should identify and depend on what pupils already know. Depending on what pupils know would mean that the pupils take center stage in all classroom activities while the teacher becomes a facilitator. As a facilitator, the teacher should do less talking and allow pupils plenty room to ask and answer questions, perform activities, discuss and report on what they have discussed. This way the needs of the rural pupils would be met.

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