OUTDOOR ACTIVITIES AND THE TEACHING OF CLASSIFICATION OF ORGANISMS IN SCHOOLS IN TANZANIA: THE USE OF DIGITAL CAMERAS

Eugenia J. Kafanabo
University of Dar es Salaam, School of Education

Abstract

This paper discusses how in-door and out-door activities can be integrated in the teaching and learning of biology to secondary school students so as to increase collaborative and participatory learning process, and construct new knowledge through discovery. The use of digital cameras in teaching classification of organisms in schools can also improve instructional processes, where students learn by inquiry, and discoveries. The study was conducted in Dar es Salaam region in two secondary schools, where 72 form three students participated and two biology teachers. Outdoor activities were used, providing an opportunity for the learners to use digital cameras and learn from sampled pictures collected. The results of the study showed that pedagogically the integration of outdoor activities and digital activities did widen learning horizons of students as well as it enhanced the educational options for educators.

Introduction

Most students tend to lose interest in science subjects, and it is thought that among the common reasons that lead to this loss include the undesired pedagogy being used by teachers in teaching and learning of science subjects, and biology courses in particular (O-saki, 2007; 2000; Parker & Gerber, 2000; Ramey-Gassert, Walberg & Walberg, 1994). Many schools in Tanzania for example, are currently teaching biology in classrooms from books, adopting more of teacher-centered than learner-centered approach where learners do no get an opportunity of observing plants, animals, insects and other natural processes from outside their classrooms (Maro, 2004; Nihuka, 2004; Murray, 1993). However, the teaching and learning of biology has always emphasized the integration of indoor (classroom experiences) and outdoor activities (real life experiences). The purpose of integrating indoor and outdoor learning activities is to provide a pervasive environment that will enable students to more extensively connect, reflect on, explain and hypothesize about the physical world around them in relation to their formal learning experiences from the classroom (Rogers, Price, Randell, Fraser, Weal and Fritzpatrick, 2005; Cronin-Jones, 2000; Lisowski & Disigner, 1991; Biggs & Tap, 1986).

Researchers who have investigated the potentials of outdoor classrooms generally agree that when the context for learning changes from an indoor, book-centered environment to an outdoor and nature-centered environment, students would find it to be a more meaningful context for education (Ozdemir & Yilmaz, 2008; Dyment, 2005; Fjortoft, 2004; Ramey-Gassert, 1997). By integrating outdoor activities, it stimulates learning as students are allowed to handle, touch, see, and smell the materials they are learning with and from. Thus, outdoor activities offer opportunities to promote hands-on activities, critical thinking, and other skills that can lead to more inquiry, then discovery and life-long learning (Kangas, 2010; Morrone, 2001).

The teaching of science can be impacted positively in terms of knowledge (cognitive learning and retention) and attitude (Knapp, 2000; Lisowski & Disinger, 1988) by using appropriate methodologies which could attract younger scientists to the field. Among them being the integration of outdoor activities (Rogers *et al*., 2005; Tal, 2001; Orion & Hofstein, 1994; Bybee, 1993), combined with the use of technology in teaching and learning of science subjects by use of computers, digital cameras, mobile phones in outdoor activities (Ruchter, Klar, Geiger, 2010; Uzunboylu, Cavus, Ercag, 2009; Chen, Kao, & Sheu, 2003).

This study was conducted to explore how the teaching of classification of organisms in schools could be enhanced by the use of digital camera technology integrated in classroom activities (Ktoridou & Eteokleous, 2005). Digital cameras are now a common gadget in a day-to-day activity, and various attempts have been made in order to use them in classroom activities. The pedagogical challenges related to integration of digital cameras in the teaching and learning process is to find ways on how the digital cameras can be authentically integrated into classroom activities as well as successfully addressing all parameters related to teaching and learning (Underwood, Smith, Luckin, & Fritzpatrick, 2008) and how to influence digital cameras integration in education. The pedagogical assumption is that the integration of digital cameras will widen the educational horizons of students as well as enhance the educational options for educators.

Purpose of the study

The researcher through experience found that the O-level curriculum does not promote the use of outdoor learning experiences in the teaching of classification of living organisms in most schools, despite the fact that many schools are surrounded with good yards, gardens and or micro habitats. The process of teaching can be supported by use of digital camera and images

where teachers and students can make use of outdoor environments or the school yard. It can be said that the main challenges that many teachers face, including teachers in secondary schools in Tanzania, is provision of meaningful learning opportunities that they can design, technology-enhanced, inquiry based learning opportunities for students. The main aim of this study was to explore the use of outdoor activities and digital cameras in the teaching and learning of biological classification of animals in the secondary schools. Also this study assessed the pedagogical changes that were achieved in the process of teaching and learning using outdoor activities and digital cameras.

Research questions

The following were the research questions used in the study:

1. What are main teaching and learning strategies and resources used by teachers in teaching biology in secondary schools?
2. How are students involved in the teaching and learning process of biology in schools?
3. What will be the reactions of teachers and students in the use of digital cameras in learning biology in outdoor activities?

Literature review

The teaching of biology and especially the topic of classification of organisms in Tanzanian schools has always been a challenge for the teachers and students. For teachers, for example, it has been hard to develop stimulating lessons that showcase the diversity of organisms, and how they are similar and different by using real life experiences through the environment (Cronin-Jones, 2000; Keown, 1986). What is commonly practiced by most teachers in Tanzania for example, is that samples of organisms are brought in the classrooms (of which it is not a bad idea) or sometimes they teach by means of pictures drawn on manila sheets, or use of pictures from books (Osaki, 2002; Maro, 2004). However, this type of teaching does not allow students to participate in the learning process as they are always using ready made pictures, where it creates a distance from reality and learners thinking.

At the same time it has always been a challenge for the students who want to learn the diverse groups of organisms by learning their similarities and differences, knowing the different hard and scientific generic and specific names of organisms. Biology like any other science subject is ever-evolving and involves lots of experiments and new discoveries; hence, teachers need to reform old classroom practices (Osaki, 2007; Chonjo & Welford, 2001; Chonjo *et al.*, 1996) by engaging learners in actual hands on activities using

inquiry-based methods of teaching, and outdoor activities (Orion & Hofstein, 1994; Bybee, 1993).

For example, one of the most common questions asked by the beginning biology students is "why do we have to learn so many terms?" Many students become discouraged with the course because of the unfamiliar vocabulary required to understand the subject matter (Kessler, 1999). Wandersee (1985) affirms that "there are more new words introduced in the beginning of every biology course than in a first year study of a foreign language". Yager (1983, p.577) also points out that "there has been strong evidence that one major fact of the current crisis in science education is the considerable emphasis upon words/terms/definitions as the primary ingredient of science".

The concern of this study is that the study of organisms and their diversity has been popularly taught as a traditional biology course; however, in recent decades, according to Mayer (1993) and Yore & Boyer (1997) there is a shift in the teaching of biology, where emphasis has become increasingly dominated by physiology, molecular biology and genetics. Currently, the biodiversity crisis has generated renewed interest in organismic biology and has evoked demands for greater emphasis on the study of organisms and their diversity in education (Mallow, 1994). This is why students need to work much harder and move away from being passive recipients in the learning process of chain of names and information as in classic taxonomy education (Crisci *et al*., 1993). In one of the survey study that was done in Germany, most experts thought that biodiversity education should be an active process, in which students can (a) observe and investigate plants and animals in their immediate environment, (b) become knowledgeable about local species, and (c) understand and value biodiversity (Mayer, 1992). But this is not what is happening in real classroom situations in Tanzania in particular.

The main idea of teaching and learning of biology has been and is, to engage learners who actually do not like biology to better understand key scientific concepts through hands-on activities (Wee, Fast, Shepardson, Harbor & Boone, 2004). The results of the study done by Feldman, Coulter, and Konold (2000) from schoolyard ecology noted that several students who had trouble understanding text-based information responded enthusiastically to more visual information such as data displayed with graphs, pictures and drawings. The involvement of the students in learning using real situations for example the use of outdoor activities can result to connections in science concepts in real world problems (Cronin-Jones, 2000; Knapp, 2000). Moreover, learning using real world activities allows students to collaborate with peers through

small group projects, by sharing and highlighting the diversity of habitats within the school yard (Feldman *el al.*, 2000). Moreover, learners can learn more quickly, appreciate the experiences gained and retain the skills learnt much longer (Knapp, 2000; Tanner, 2001).

Another advantage of learners using technology in learning of organisms using outdoor activities and technology is that students can learn different skills by using different types of multimedia and multidisciplinary approaches, and become more involved in using technology. This means that learners can be able to explore on their own what they want to do e.g. create pictures or portfolios, and at the same time positively impacting on knowledge and attitude of the students (Van Scoter, 2004; Knapp, 2000).

Another reason for the use of technology is to prompt pedagogical change in the way teachers teach and the way students learn biological science by "doing" and by working side-by-side in the application of biology knowledge. The power of using digital cameras and images with students seems to lie in the way in which it engages students in the learning process (Van Scoter, 2004; Rodden & Wood, 2003). For example, the image might stimulate curiosity and provide rich opportunities for visual communication, and provide another way to conveying meaning and share experiences. Digital cameras for example, are feedback tools that can allow students to see and reflect on activities as they happen and offer new ways to record and document learning. Furthermore, the use of digital cameras might be motivating, empowering and fun (Van Scoter, 2004, p. 35).

Methodology

A qualitative research approach was used, and case study design which enabled the researcher to get in-depth information on how outdoor activities and digital cameras could be used in the teaching and learning of classifications of organisms in secondary schools. The study was conducted in two government co-education secondary schools, one from pre-rural Dar es Salaam and the other one was from Coast Region. These schools were purposively selected because they had good compounds with variety of plants, small habitats with running water (fish, frogs and butterflies were seen); hence students were expected to take pictures of pants and animals using digital cameras. A total of 72 Form Three students participated in the study; they were randomly selected from the four science stream classes in these two schools. Twenty eight students were selected from the first school and 44 students were selected from the other school with the age range of 15-19, where 38 were females and 34 were males. Two biology teachers (one male

and one female) also participated in the study, one from each school (teaching biology to the science stream class).

The first part of the study included the researcher observing each teacher as they taught their students according to their lesson plans. According to the school timetable, the Form Three classes have a total of 4 periods per week for biology, 2 periods are for the theory class and 2 periods for practical, and each period is 40minutes. All the teachers were observed twice each week, for a theory and practical class, for two weeks. The observations were done to allow the researcher assess the teaching strategies and resources used by these teachers as they taught classification of living organisms to these science classes prior to the outdoor classes that were planned by the researcher. During each theory and practical session, the researcher identified the difficult part, which needed to be included in the outdoor activities.

The second part of the study was students and their teachers participating in outdoor activities as prepared by the researcher. The activities included instructions for the students, worksheets, polythene bags were used to keep collected specimens. Each group received 2 polythene bags (1 for keeping plants and the other one for small insects e.g. grasshoppers, ants, and butterflies), and 1 still digital camera. In this study, there were a total of 6 digital cameras only. Enough time was used by the researcher to discuss with the students before the outdoor activities. The researcher also introduced the students to the use of digital camera, and how to take pictures at different positions and be able to zoom the organisms for easy identification of different features. The outdoor activities ran for three weeks, once each week, during practical classes.

Both teachers who participated in the study were participant observers. And after each outdoor activity, there was a reflective session that was conducted between the researcher and the biology teacher to share the observations made while working with the students and the use of digital cameras and learning of biological classification. After the first two weeks of outdoor activities, the teachers were also allowed to prepare activities for the nest outdoor activity, using samples of instructions and worksheets used in the previous activities.

Finally, selected specimens that were collected by the students were preserved in the biology laboratory, by the help of a laboratory technician. Small insects for example cockroaches, grasshoppers, and ants were preserved in jars using chloroform. Both schools did not have computers for students' use, so, all the pictures that were taken by the students were downloaded using researchers

laptop computer. After each discussion session, the students selected some of the pictures to be printed, and the printing was done by the researcher. All the pictures that were printed and all the summaries students prepared from the worksheets were kept in student group files as portfolios which were later analysed by the researcher.

A questionnaire was administered to all the students who participated in the study with the aim of identifying the how they learn biological sciences and what is their recommendation after participating in the outdoor activities and use of digital cameras.

Findings and discussion

Teaching and learning of biological classification in the schools

The teaching and learning of biological classification done by teachers, the researcher realized that both teachers preferred to teach by using lecture method and writing notes on the blackboard for the students to copy in their note books and constituted approximately 90% of their teaching time. The other 10% preserved specimens were used to supplement their teaching and sometimes these specimens were insufficient for use by all the students in the class. The students cannot observe easily in their groups, sometimes these specimens do not have all the respective parts. For example, the researcher observed that some specimens had broken limbs, and therefore did not provide all the features needed for the learning of classification of organisms. Therefore, the laboratories were rarely used as a verification of what students have been told in class or what they have read in textbooks.

During the reflective sessions with the teachers, they both said that the use of preserved specimens was to supplement their teaching with materials that cannot be found in their environment for example, cones, shells, marine organisms, worms, and plants that are very rare including ferns. All these were preserved to save time for searching new specimens each time they teach a class and have to use discussion method to teach these organisms. This could have been a good strategy of teaching and learning biological classification if students were also allowed to participate in the collection and preservation of the specimens for example, going out to collect and see the *coniferophyta* plants. Therefore, the preserved specimens were often used as 'add-on' during the lecture type teaching.

On the other hand, there were fewer teaching methods and activities that allowed or could involve students in hands-on activities such as observation of different organisms in their natural habitats or use students' familiar

environment like the school yard. Moreover, the students were not given an opportunity even of collecting specimens according to instructions from the school. These results are also supported by studies done by O-saki (2002) and Chonjo *et al*., (1996) in sampled Tanzanian schools and found out that most teachers use 'talk and chalk' teaching method, where most of the time is spent by the teacher talking and students writing notes. Fewer interactive activities are undertaken and emphasis is placed on learning by memorization of facts, ready for examinations.

On the other hand, the data from the student's questionnaires showed that, 59 students (83.09%) mentioned that the dominating or common method used by their teachers in teaching of biological classification were lecture method, teachers writing notes on the blackboard and the students copying these notes in their exercise books. The remaining 12(16.91%) students mentioned that the discussion method was another method that was commonly used in teaching biological classification. It can be concluded that, these teachers mostly used lecture method, discussions in form of question and answers from the students as their main way of delivering information about biological classification. The lecture method was important to allow coverage of the syllabus and not for development of the basic scientific skills such as investigation, discovery through observations, and conducting experiments. This was also observed by (Hurd, Bybee, Butler Kahle, & Yager, 1980) that biology teachers lecture more than 75% of the time, so little time is left for inquiry. The choice of this type of pedagogy however, could have been attributed to the large number of students. For example, the schools that were observed, the classes had 90, 80, and 100 students respectively. During an informal discussion with one of the teachers, she said that the lecture methods dominates most of their instructional processes because it helps them to control students' behaviour, be able to cover enough curriculum content, and reduce hassles to supervise students in outdoor activities.

However, the methods used by teachers to teach biological classification do not foster students' understanding of scientific principles and ideas, but rather prepare students' to be tested for facts through rote learning. These results are also supported by a study that was done by Hongoke (1998) who revealed that science classes in Tanzania are still taught in an authoritarian fashion, and predominantly include a lecturing style and use of preserved specimens to show that science can be traced back to laboratories and is complicated. This style of teaching is still dominant in most classes in Tanzanian schools.

Outdoor activities and the learning process

In this study the outdoor activities were pre-planned by the researcher to include tasks that involved the students and the teachers of the selected schools. For example, their first task was to start collecting plant samples that would match the classification of *monocotyledons* and *dicotyledons* in their school compound, following what they have learnt in class in the first two weeks. Students were divided in groups of 4 students, and each group had a polythene bag to keep their collections. Safety was paramount, as the researcher and the class teachers were there to supervise the students as they picked the plants, checked on the plants that were picked, and monitored the students as they walked in the school yard. The whole process took about 20 minutes.

Students worked together, and at the same time discussed along the way as they collected the samples. The discussion played a major role in students' ability to work through various materials as it was an opportunity for them being out of their classes on that day. For example, these students' talked to each as they picked each plant the discussion was if the samples matched the features of monocots and dicots plants they have learnt. The outdoor activity was as they were able to collect samples of specimens from their school yard, work together in groups and learn about living organisms and their environment. During an informal discussion one of the students said:

> *"We enjoyed the walking and learning around our school compound, it is something different, it has changed the learning process as we are used in sitting in the classroom and listen to the teacher, it is not fun at all".*

Most groups collected as many samples as possible for their discussions that were conducted later in the biology laboratory (that is where the class was). Back in the biology laboratory each group sat down and spread the plants on the tables and started the basic categorization of the plants according to the features they have learnt in their earlier classes. The process of sorting of the plants also involved taking pictures using their digital cameras. Students took pictures of these plants to show different parts of the plants that showed other observable features including the roots, the stem and the leaves.

In the process, one of the group came across a cacti plant and had a heated discussion on whether the '*cactus*' is a monocot or a dicot. This was a good sign they are now trying to be more investigative, as they wanted to know the differences which most of them were not as distinct as what was seen from other plants. These students were informed that monocot plants are

angiosperms that have long leaves, with parallel veins, with adventitious roots. On the other hand, the dicot plants have short leaves and reticulate veins, and a taproot. Some of these features (of the leaves and stem) were not seen on the cactus plant. The students then decided to use the pictures taken from the digital cameras of the cactus plant, as they made a plan of how to look out for the information required and how to classify the plant. Pictures are as shown in figure (i) and (ii).

Figure (i): Roots of a cacti plant as presented by students.

Figure (ii): Leaves and stem of a cactus plant as presented by students.

As the students sat in their groups in the biology lab, the students had a chance to discuss, touch, open the leaves and spread the root system, distinguish and make comparisons between plant leaves, stem, roots and seeds (for those with seeds at the time of collection) and finally summarize all the information on their worksheets. They managed to integrate their knowledge according to their observations. Students were also able to discuss about the cactus plant, they could see the roots which were fibrous and some very small leaves which could not be easily seen from the pictures in their textbooks. This was one of the learning experiences that most students said they cherished as they were able to classify the unknown plant (to them by then) as a monocot plant.

From this type of learning experience, most students said they would not forget the information easily. They said they would be able to identify other organisms even if not in a classroom setting as they now have the skills to do so. Students were highly motivated by the type of lesson they carried out, because they were able to work hard to clear the doubt by bringing the specimen to the class to be observed and discussed. This shows that integration of the local environment in teaching is preferable than just depend on the text book. This is in line with the findings of (Lindholm, 1995) who

found that students' activity in natural school yards allows more creativity than students' activities in their classes. Moreover, (Fjortoft & Sagie, 2000; Fjortoft, 2004) also found that local environments positively affect learning and cognitive qualities, and can impact knowledge and attitudes of the students.

To emphasize on the importance of using outdoor activities and use of digital camera, in another observation during one of the activities, students went out to identify plants from wet areas. They were supposed to distinguish between moss plants and algae (spirogyra). Since they were used in pictures from textbooks, most students made mistakes on classifying the organisms, for example, the algae was mistaken to be a moss plant. It was not surprising as most pictures in books are magnified samples, and students could not distinguish the two organisms easily. Hence, seeing the moss plant in its natural environment, students found it very difficult to relate it to a picture. The advantage of using digital camera gave them an opportunity of taking pictures and zoom more to get finer features of the organisms. The mouldy spirogyra was not collected by the students for safety reasons. The pictures are as shown in figure (iii) and (iv).

Figure (iii): Moss plants growing near a river **Figure (iv):** Algae growing on moist surface

After, the discussions, the moss plants were observed under a microscope, and the students were able to draw the required features of a moss plant. These results concur with the standards set by NRC (2000) that learners do go beyond merely hands-on experiences, but, they are also actively engaged in discovering a phenomena, at the same time exploring possibilities and making sense of learning scientific ideas through inquiry (Wee, Fast, Shepardson, Harbour, & Boone, 2004). Hence, the use of the local environment provided relevancy to the biology class and the teaching of biological classification, as

learning was connected to the outside of class and at the same time encouraged learning scientific facts.

All the pictures that were taken by the students in each group were printed and pasted on plain papers and kept in their files, including their worksheets, and reports. All the students prepared group portfolios of the documents, and they also took more pictures from their own localities that showed how people use the knowledge of classification to classify other things to simplify their work (transfer of knowledge). For example see appendix 2, and figure 6. A picture of a local kiosk was added in one of the portfolios to show how people in the local market and local kiosks arrange things following the knowledge of classification.

In another portfolio, the students had collected several pictures of living and non living things, than drew a table to show how these organisms could be classified as shown in figure 5.

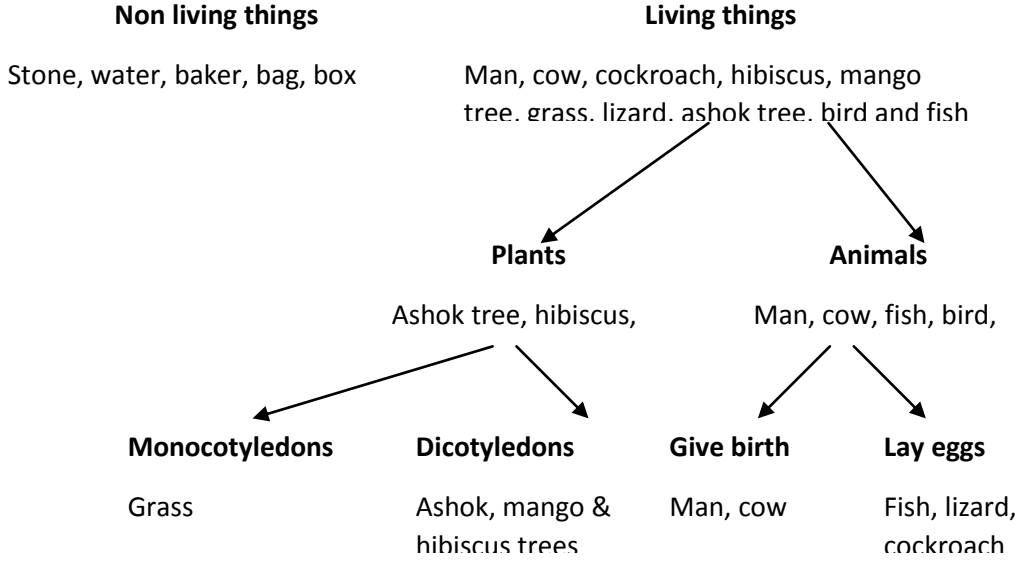

Figure (v): Classification of living and non-living summarized by students.

In assessing what was achieved in terms of pedagogy after the introduction of outdoor activities and uses of digital cameras, first the learners worked collaboratively in the collection of samples (hands-on) in their groups and between groups. Moreover they also got an opportunity to discuss their samples to their colleagues and each student had a chance to contribute to the presentation. Moreover, the students were able to use the process of inquiry and discovery in the identification of the cacti plant and the spirogyra. Ramey-Gassert, (1997) asserts that in order for science to be taught in the manner that students learn best, than teachers have to use hands-on activities, engage in investigations using simple everyday materials as were used in this study.

On the other hand the use of digital camera in this study also was an added advantage where it necessitated the acquiring of knowledge by students constructing their own knowledge that led to new understanding through observations, discussions, presentations and the use of portfolio compared to acquiring knowledge through conventional, didactical instructional processes (Schiller & Tillett, 2004; Van Scoter, 2004). As it was mentioned earlier all the teachers who were observed used conventional didactical instructional methods, which did not engage students in the process of learning, and did not give an opportunity to construct new knowledge through inquiry and discovery.

Conclusion

The use of digital cameras in the teaching of biological classification helped the teachers appreciate the potential of the outdoor activities in their teaching. First it allowed students to collect specimens of their choice and variety, which made the lessons much more interesting in terms of discussions, and classification process. Moreover, students made use of the digital cameras to take pictures, zoom more to get finer features of the samples and these features helped them in their discussions and classification process. For example in the classification of the cacti plant, the students could see the rots which were fibrous and some very small leaves which could not be seen easily from the pictures in their textbooks. Students learnt by using these discoveries and were able to classify the unknown plant (to them by then).

On the other hand, different photographs that were collected by the students during the study were used to prepare portfolios that they kept for their future references. This type of pedagogy in the teaching of sciences could allow learning of the basic scientific skills and allow student involvement in the learning process.

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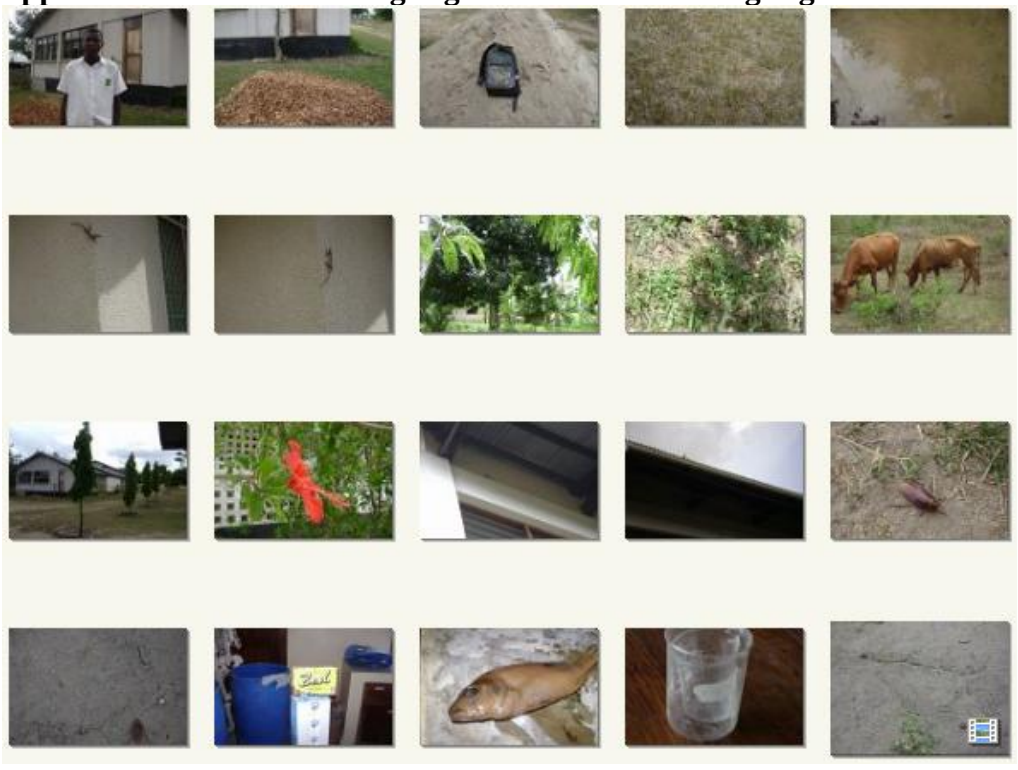
Appendix 1: Pictures of living organisms and non-living organisms



Appendix 2. Grouping of simmilar things in the day to day activities (transfer of knowledge)

Figure (vi): Grouping of items in a local kiosk.