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Research Article

Secondary School Agriculture Students' Perceptions toward Inquiry-based Learning in Nandi County, Kenya

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Abstract: This study aimed at determining the perception of secondary school Agriculture students towards inquiry-based learning in Nandi County, following a practical in soil science containing an element of inquiry. The education sector in Kenya is shifting towards Competency-Based Curriculum that requires learners to engage in Inquiry-Based Learning to develop the required competences and the 21st-century skills such as collaboration, communication, teamwork and problem solving among others. This study was guided by the Constructivism and Bybee's 5E learning cycle model, which is an Inquiry-Based Teaching (IBT) approach model. The students were put in groups of 4-5 and provided with the following: Soil auger, trowel, two clean buckets, small cartons,3 test tubes, distilled water, pH indicator, pH colour charts and Barium sulphate powder which they were to use to carry out soil sampling and soil pH testing. After the practical, students completed a five Likert scale questionnaire. 26.3 per cent strongly agreed, and 73.7 per cent of the students agreed that detailed instructions should be given about how to carry out each practical. In answer to the statement "I'd value the opportunity to design and carry out my own experiment," 14.4 per cent strongly agreed while 25percent agreed and 54.2 per cent were neutral. The anxieties expressed by the students were that they would not understand the practical. These findings suggest that considerable thought needs to be given as to how to best introduce secondary agriculture students to inquiry-based learning activities by Ministry of Education, teachers and the Kenya Institute of Curriculum Development (KICD).

Keywords: Inquiry-Based Learning, Students' Perception, Soil Science Practical.

INTRODUCTION

Traditionally Agriculture practicals have involved students following step by step instructions to arrive at the results of experimental phenomena. Not only is this approach referred to as boring by the students, but it is also reported to limit the development of experimental competencies and conceptual knowledge (Utami, & Sundari, 2019). As a result, the focus of the students becomes that of obtaining correct results for the ongoing syllabus coverage and failure to understand the whole concept of the experiment. The assessment of students and learning in secondary education for the years 2015, 2016, 2017, 2018 and 2019 at Kenya Certificate of Secondary Education indicated that students in agriculture had a declining performance countywide (Andiema, & Kitainge, 2016).

Against this background, it can be argued that students' achievement in agriculture may be enhanced if a student-centred teaching method is employed during learning sessions. Perhaps, one method that might bring change in student learning outcomes in agriculture in secondary schools is through inquiry-based teaching method. Inquiry-based Learning entails students shaping the question under inquiry, developing the methods, materials, and data, and producing a report based on results (Ongowo, 2017).

In Kenya, teacher-centred instruction still dominates the current 8-4-4 system of education. The use of lecture is still the dominant teaching method. This has received criticism as being theoretical, making learners be receivers and not creators of knowledge (Njoya, 2018). On the other hand, inquiry-based practicals provide the students with the opportunity to create their own hypotheses and design their own experiments. This promotes the development of higher-order thinking skills such as creativity, critical thinking, independent thinking and reflection (Cox, 2014). It also improves the attainment of the desired learning outcomes (Kaka, 2017).

The students become active learners who show greater engagement and motivation alongside increase curiosity and enjoyment (Tom, 2017). When inquiry-based learning has been used consistently, students often device experiments at the same level of sophistication as in their introductory topics in Agriculture. However, if inquiry-based learning is introduced without any preparation of the learners, this can increase the students' anxiety and leave them in an uncomfortable struggle with increased frustrations (Gormally, 2017). It has been reported that changing a traditional style of teaching to an inquiry-based approach does not automatically improve the learning

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outcomes (Alonzo, 2018). This suggests that the question of whether to introduce inquiry-based learning in secondary agriculture classes is not straightforward and that students' attitudes play an important role in determining whether inquiry-based learning can be successfully implemented. The purpose of this research, therefore, was to determine the perception of secondary school agriculture students in Nandi County towards inquiry-based learning.

By determining the perception of secondary agriculture students, it would be possible to establish whether there are trends in the students' perception of the benefits of the new curriculum reforms. The findings of this study are essential to professional learning, and the improvement of teaching practice in that highly accomplished teachers thrive on reliable and valid feedback from their learners. Feedback makes the teachers more effective in their teaching and application of new teaching strategies. Students are the ones who know whether explanations are clear, whether to ask for help, whether they're asked questions that make them think, whether they get a chance to participate in class discussion and whether teachers make them interested in a subject. This may be appropriate because test scores as used by the Kenya National Examination Council can only reveal when students are not learning and cannot reveal why (Schleicher, 2018).

The Government of Kenya recognises education as the pillar that promotes the achievement of the Big Four Agenda. However, low performance in education has been a challenge for the past several years. The importance of secondary agriculture in the present climate change and food security cannot be underestimated. However, observation and reports from the Kenya National Examination Council (KNEC) revealed that a high percentage of secondary school students continue to perform poorly in agriculture.

Many students appear not to achieve the expected learning outcomes in agriculture, especially in soil science. This poor performance may be attributed to many factors among them traditional teaching methods which dominate the agriculture classrooms. It has been reported that changing a traditional style of teaching to an inquiry-based approach does not automatically improve the learning outcomes (Alonzo, 2018). This suggests that the question of whether to introduce inquiry-based learning in secondary agriculture classes is not straightforward and that students' attitudes play an important role in determining whether inquiry-based learning can be successfully implemented.

METHODOLOGY

The study was carried out in Siwo public co-educational secondary school in Nandi County where students had been introduced for the first time to Soil science. A quasi-experimental design was employed in this study. Hence there was a non-random assignment of students to the groups. 38 out of the 74 form two agriculture students took part in the study. Inquiry-based practical in soil science was developed by the researcher to provide context for the students. The students were given a lecture on soil sampling and a demonstration by the researcher on how to test the P^H of a soil sample obtained from their school farm.

The lecture included definition of soil sampling, methods of soil sampling, precautions taken when carrying out soil sampling, soil testing and soil p^H testing. An introductory lecture was given before the students started carrying out the experiment during which they were told they would be given the following: Soil auger, trowel, two clean buckets, small cartons,3 test tubes, distilled water, pH indicator, pH colour charts Barium sulphate powder and an internet-enabled smartphone. The first learning outcome was for the students to identify the apparatus and state their uses. Secondly, they were given the apparatus; however, they were not told which apparatus is used in which experiment. The third outcome was to take precautions in which areas to avoid while collecting soil samples. The researcher was available throughout the experiment. A full laboratory report consisting of introduction, aims, methods, results, discussion and references was required.

The students worked in groups of 3-4 which amounted to 10 setups, a maximum of 40 students in the laboratory. Each group was expected to design experiments using the apparatus provided by the teacher that covers three of the four levels of Inquiry-based learning. They had a total of 80 minutes to complete the two experiments; to carry out the soil sampling in the school farm and to determine the p^H of the collected soil sample. The experiment required that student observed the precautions taken when carrying out soil sampling and correct procedure when carrying out soil testing for p^H. Otherwise, it would give incorrect results, so the students were informed about the importance of being accurate with their procedures.

To perform the experiment correctly, the students need to have collected topsoil at a depth of 15-20cm and subsoil at a depth of 20-45 cm randomly from the school farm using clean buckets then mixing it thoroughly before putting it in a sampling carton. By not collecting soil from the fences, manure heaps, charcoal burning sites, recently fertilised areas, and near cattle kraal then the students would be able to obtain the correct results. The students adopted various strategies for approaching the problem. Some groups joined together and shared the tasks between themselves. All the groups had an internet-enabled smartphone, and some groups used Google to find out which procedures came first. Other groups simply used the trial and error approach.

During the course of the practical 38 students out of a possible 43 completed a questionnaire and survey. The remaining students were either absent on the day of the experiment or chose not to participate. The questionnaire consisted of 3 statements adopted

from the McGill Strategic Demands of Inquiry Questionnaire (MSDIQ) which is a 79-item, criterion-referenced, learner-focused questionnaire that addressed three phases of inquiry engagement: planning, enactment, and reflection by Shore et al. (2012). The questionnaire consisted of 4 statements covering the students 'attitudes towards inquiry-oriented learning. The items were arranged on the questionnaire. Students were asked to rate each statement using a 5-point Likert scale consisting of the categories: strongly agree (SA), Agree (A), neutral (N), disagree (D) and strongly disagree (DS). The number percentage of students answering in each category was calculated. Part two of the questionnaire had one open-ended question asking the students to describe briefly any particular expectations and anxieties they may be having as they begin the laboratory experiments in Agriculture. The questionnaire was anonymous, and students were informed their participation was voluntary. The students were asked to complete and return the questionnaire before leaving the laboratory.

LITERATURE REVIEW

Inquiry-based Learning entails students developing the question under inquiry, developing the methods, materials, and data, and producing a report based on results (Tom, 2017). The Institute for Inquiry defines inquiry as "an approach to learning that involves a process of exploring the natural or material world, and that leads to asking questions, making discoveries, and testing those discoveries in the search for new understanding" (Eisner, 2017). This may not always be possible in every classroom with every subject. For the purpose of this research in secondary Agriculture, inquiry-based learning will include lessons that incorporate at least partial inquiry with active engagement, exploration, explanation, elaboration, and evaluation (5Es) as used in inquiry-based learning (McKim, Velez, & Sorensen, 2018). The 5E model was developed by Rodger Bybee to help teachers approach instruction in a meaningful way and enhance student learning (Bybee, 2014). The 5E learning cycle, therefore, is considered as a method to use in creating an effective student learning environment when used with inquiry-based learning (Bybee, 2014).

Agricultural education concepts are steeped in the sciences of biology, chemistry, physics, and mathematics. With inquiry-based instruction, students become engaged in many of the activities and thinking processes that scientists use to produce new knowledge hence improving performance. The students manipulate materials, make discoveries and share their findings with classmate and teachers. The teacher's role is to provide, scaffolding by observing, questioning and guiding. Exploration provides concrete experience from which student learning and knowledge can be built (Maonga, 2016).

An Effective Inquiry Is A Complex Process Involving Four Levels:

1. Confirmatory inquiry - In this kind of inquiry, the teacher has absolute control over every phase of the process and makes all the decisions. Students are provided with the question to be answered, the procedure as well as the results of an investigation. The teacher also provides all the necessary information, materials and apparatus and asks the students to carry out the procedure.

2. Structured inquiry: In this kind of inquiry, students are provided with questions, methods and materials and are challenged to discover relationships between given variables or answer to t **3. Guided inquiry**- In this kind of inquiry, students are provided with a question. However, the method for research is up to the students to develop.

4. Open inquiry- In this kind of inquiry, phenomena are proposed to students, but students must develop their own questions and method for research to discover relationships among variable

Thoron and Burleson (2014) conducted research in an agricultural education classroom on student perception in agriculture and in inquiry-based learning. Over seventy per cent of students agreed or strongly agreed that Inquiry-based learning is useful for solving everyday problems, and they have a real desire to learn agriculture. Over half of the students said they would like other classes to use inquiry. Eighty per cent of students reported that they enjoyed doing lab activities in class (Wells et al., 2015). The results of the study indicate that inquiry-based instruction is effective for increasing students' interest in agriculture.

FINDINGS AND DISCUSSIONS

Secondary Agriculture Students' Perception towards Inquiry-Based learning

The objective of this study was to determine the perception of secondary school Agriculture students towards inquiry-based learning. Figure 1 shows the percentage of students answering in each category for statements related to inquiry-oriented learning.

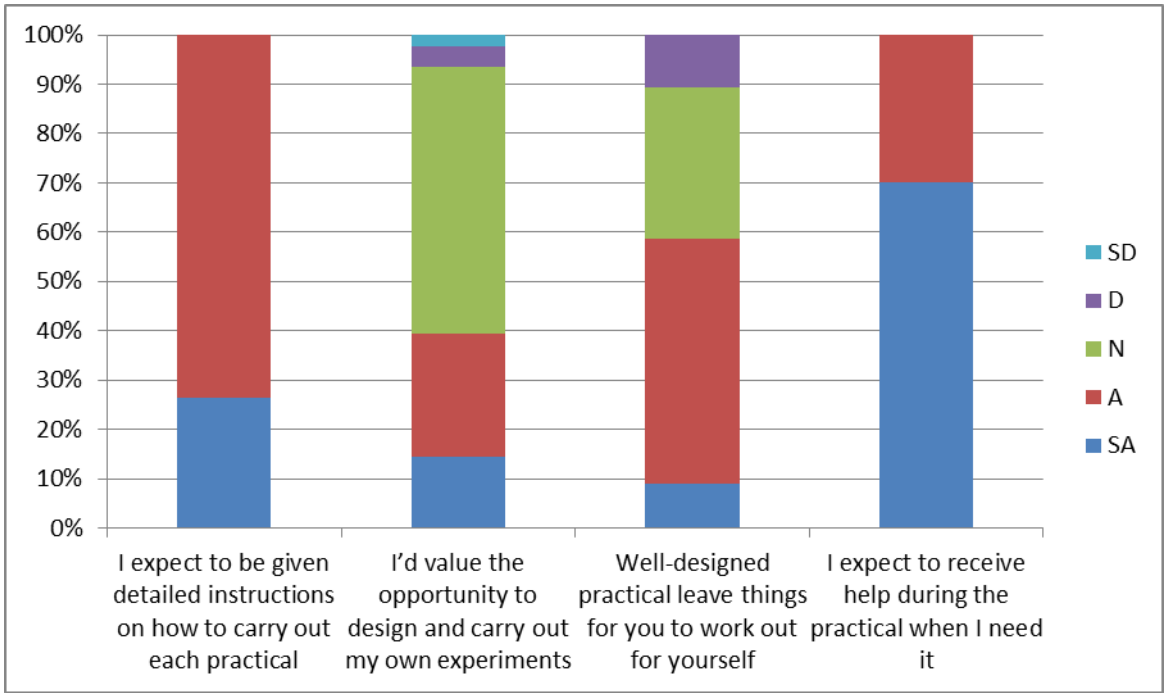

Figure 1: Secondary Agriculture students' perception towards inquiry-based learning

For the statement that stated 'I expect to be given detailed instructions on how to carry out each practical, students were very positive about being given detailed instructions on how to carry out each experiment with 26.3% strongly agreeing and 73.7% agreeing. No student either disagreed or strongly disagreed about this. For the statement that stated that 'I expect to receive help during the practical when I need it,' there was also a firm belief that help should be provided when needed with 70.1% of the students registering strongly agreed, 29.9% agreed, while no student disagreed or strongly disagreed. For the statement that stated 'I'd value the opportunity to design and carry out my own experiments,' students were less decisive about whether they wanted to design and carry out their own experiments with 54.2% answering neutral, whilst 25% agreed, and 14.4% strongly agreed. Only a total of 4% of students disagreed, and 2.4% strongly disagreed. And in the answer for the statement that stated 'Well-designed practical leave things for you to work out for yourself,' 9% of the agriculture students strongly agreed, 49.6% agreed, 30.4% were neutral and 10.7%disagreed.

On the second part of the questionnaire, there was one open-ended question concerning students' anxieties about inquiry-based practical. 31 0ut of 43 students stated their anxieties. The answer with the most responses was that students got confusion and that they did not like getting lost in the practical. Other responses were that they did not understand what they were supposed to be doing. Since there was a practical write up that was required that amounted to their end of term grade, the students reported having been anxious about the quality of their experiments and the results obtained. They also expressed their desire to leave the laboratory in good time so as to reach the dining hall for their lunchtime meal on time because the lesson was to end at lunch break.

DISCUSSION

There has been an increasing move towards the introduction of inquiry-based practicals, where students play a greater role in hypothesis generation and experimental design. According to the Standard newspaper of 1st September 2017, it was reported that a total of 166 mathematics, science and technology teachers drawn from secondary schools in Kwale, Taita Taveta and Lamu Counties in the Coast region underwent a five-day training on Inquiry-Based Learning (IBL) in the latest such effort that has seen select teachers from various regions undergo short in-service education training (INSET) to equip them with skills that they in turn pass to others in their schools(Ombuor, 2017). IBL is an open-minded approach anchored on questions, research and curiosity on the part of students as opposed to cramming, (Ombuor, 2017). However, when this involves a sudden transition from the traditional step-by-step instructions to full practical design, this can leave the students feeling uncomfortable (Ercan, 2014) and struggling (Oppong-Nuako et al., 2015). In this preliminary study aimed to investigate student perceptions about inquiry-based learning in secondary Agriculture students in soil science after a practical containing an element of inquiry.

CONCLUSION

In this research, majority of students with 70.1% expecting help and detailed instructions during the practical class activities, while only 25% of the students expressing a desire to design and carry out their own experiments. This concern from the agriculture students may delay the implementation of

inquiry-based learning in secondary Agriculture classrooms.

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