

Domain-Specific Beliefs of Biology Teachers about the Subject on the Integration of Technology in Instruction in Secondary Schools in Kenya

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Abstract: *Information and Communication Technology (ICT) has a key role to perform in aiding education deliver its mandate of transforming Kenya into an industrialized nation as envisaged in the Kenya vision 2030. It is therefore essential that it is integrated into the teaching of all subjects in the school curriculum, biology inclusive. Its application in teaching contributes to effectiveness in delivery of the content. However, this is met with many challenges as many teachers do not seem to prioritize the use of technology in biology teaching and instruction based on the teachers' beliefs about the description of the subject and how it should be taught. The beliefs about biology can be categorized into three distinct groups: The Scientific-Innovative, Pedagogical-Innovative, and Scientific-Conventional types. The purpose of this research was to examine the domain-specific beliefs held by the teachers of biology about the nature of the subject and its instruction and the effect of these beliefs on the integration of ICT in instruction in secondary schools in Kenya. The study was conducted in secondary schools located in Bungoma County. The objective of the study was to identify the distribution of the teachers of biology in the three belief categories. The study was based on the social constructivist learning theory as proposed by Lev Vygotsky. The study adopted descriptive survey design. The study targeted secondary school biology teachers who have received professional training. Stratified and simple random sampling techniques were applied to ensure equal representation of the schools (sub-county, county, extra county and national schools), teachers. Data were collected using questionnaires, observation schedules, and analyzed using descriptive. The descriptive statistics included means, frequencies and percentages. The data is presented in the form of tables, graphs and pie charts. The study made known the distribution of biology teachers in the three belief categories held by the teachers of biology about it on the integration of ICT in biology instruction in secondary schools in Kenya. This may pave the way for interventions to facilitate proper integration and meaningful instruction which will lead to acquisition of the pertinent knowledge, skills, attitudes, and competence for further training.*

Keywords: Domain-specific beliefs, Technology Integration, Classroom Instruction

1. Introduction

The Kenya Vision 2030 is a national development blueprint formulated in the year 2007 to create a universal competitive and thriving nation with a high quality of life by the year 2030 (RoK, 2007). It purposes at transforming Kenya into an industrializing, middle-income country offering a high quality of life to all its citizens with a clean and secure environment. The overall goal being the eradication of illiteracy by escalating access to education, increasing transition rates from primary to secondary schools, and expanding access to university education with prominence on science and technology courses (Ibid).

Science, Technology, and Innovation (STI) form part of the six foundations of the Vision 2030. The government is committed to creating and implementing an STI policy framework to support the realization of Vision 2030. It is noted in the Vision 2030 blueprint that more resources will be set for scientific research, procedural capabilities of the personnel, and in fostering the quality of teaching of Mathematics, Science oriented and Technological studies in Schools, Polytechnics and Universities (RoK, 2007). The other strategies to achieve these goals include reforming secondary education and modernizing teacher training. Performance in science subjects is therefore of great concern given that these subjects are essential in the attainment of the national goal of industrialization by year

2030 (KEMI, 2014).

Information and Communication Technology (ICT) has an essential role to play in aiding education deliver its mandate of transforming Kenya into an industrialized nation by year 2030. The ministry of education in Kenya in the Sessional Paper No. 1 of 2005, which is currently the education policy, depicts stakeholders' recommendations on how to transform education to be responsive to educational and training needs in the 21st century. The Sessional Paper provides a policy framework for Education, Training, and Research within which incorporation of modern resources in teaching and learning will take place in Kenya. It points out that ICT skills play a crucial role in boosting the economic development of the country (MOEST, 2005). It is noted that most of the productivity benefits in the developed world economies over the past decades can to a large extent be due to the role of information communication and technology. It is noted that investing in ICT capital has massive capacity to reduce costs, enhance productivity, and enhance living standards (Murakami, 1997).

The government purposes of making education the actual platform for supplying the nation with ICT skills in order to establish a dynamic sustainable economic progression. The MoE has put in focus the integration of ICT in the

school curriculum. It is envisioned in the sessional paper that effective introduction and use of ICT in education and training institutions will play a significant role in disseminating skills to the broader society and therefore create positive impressions in the economy (RoK, 2005).

In spite of policies at national level that encourage the use of educational technology during instruction, many teachers hardly use it (Barron, Kemker, Harmes & Kalaydjian, 2003). One of the major hindrance being, the readiness and preparedness of teachers to adopt technology in their instructional programmes.

According to Brinkerhoff (2006), central to the successful implementation of educational technological use in schools is the role played by the beliefs held by teachers about the nature of their subjects and the way the subjects should be taught. This is in view of the challenge it may offer to their already established instructional practices. He argues that teachers' beliefs affect their instructional practices. According to Neuhaus (2012) teachers' beliefs and their content knowledge influence instructional behavior. The beliefs of teachers lie at the very heart of teaching in various subjects.

A study carried out in Germany by Vogt and Neuhaus (2005), on biology teachers' beliefs classified the teachers of biology into three groups depending on their biology-specific educational beliefs as follows: Pedagogical-Innovative type, the Scientific-Innovative category and the Scientific-Conventional type. According to the study, the teachers of biology subscribing to the three identified groups lay different emphasis on the nature of biology as a subject and how it should be taught. The pedagogical-innovative emphasized the social aspects of learning biology, the scientific-innovative believe in teaching factual knowledge and carrying out laboratory activities, while the scientific-conventional type mainly focused on teaching of factual knowledge.

In Kenya, national examination results have revealed that secondary school students are having very low scores in sciences (KNEC report, 2018). Biology, being one of the science subjects is one of the most difficult subjects in the school curriculum. KNEC results for the past eight years attest to this. Students' performance in biology in secondary schools in Kenya has been very low over the years as evidenced in the Kenya National Examinations Council Analysis revealed in table 1.1(Candidates' Overall Performance in Biology between 2011 and 2018 Nationally) and also reported in the KNEC report 2018.

Student achievement in biology is a matter that has drawn increased attention. Low academic achievement in the subject could be attributed to many factors among which teaching methods are considered to be important. This implies that the mastery of biology concepts may not be fully achieved without proper teaching methods. The methods need to be more learner centered allowing active involvement of learners in the learning process.

2. Statement of the Problem

Biology is a fundamental science subject in the secondary school curriculum that has a role to play in enabling learners to acquire skills, knowledge, and attitudes needed for monitoring and conserving the environment. It plays a significant role in preparing doctors, technologists, genetic engineers, environmentalists, among other professionals. Given that the subject prepares learners who can pursue courses that require the use of technology, there is need to integrate technology in classroom instruction to enable them to develop the pertinent knowledge, skills and competence for further training.

Information Communication Technology is a prerequisite for global competitive quality education, training and research for progression. It has a significant role to play in enabling education serve its aim of transforming Kenya into an industrialized nation as per the vision 2030. Integration of technology in the classroom instruction is also envisaged to enhance the quality of instruction to the ever increasing student enrolment by ensuring creation of learner-centered environments.

However, this is met with many challenges as many teachers do not seem to prioritize the use of technology in classroom instruction. One such challenge could be the beliefs held by the teachers of biology about the subject which can be categorized into; pedagogical-innovative, scientific-innovative and scientific conventional. It is against this background that this study sought to investigate if the beliefs of teachers of biology about the nature of the subject and how instruction should be conducted play a role in the overall integration of information and communication technology in the classroom instruction in secondary schools in Kenya.

3. Purpose of the Study

The purpose of the research was to investigate the domain-specific beliefs held by the teachers of biology about the nature of the subject and how it should be taught and the effect of these beliefs on the integration of ICT in biology instruction in secondary schools in Kenya.

4. Objective of the Study

The objective of the study was to identify the distribution of the teachers of biology in the three belief categories of pedagogical-innovative, scientific-innovative, and scientific-conventional types.

5. Research Design and Methodology

The descriptive survey design was utilized in the study. This design enabled the researcher to determine the distribution of biology teachers into the three belief categories as follows; pedagogical-innovative, scientific-innovative, and scientific-conventional types hence exploring and describing the prevailing situation at the time of study.

The Sample

A total of thirty one schools were selected from Bungoma County using stratified random sampling to ensure equal representation of national, extra-county, county and sub-county, mixed, girls' and boys' secondary schools respectively as revealed in table 1

Table 1: Categories of Schools by Classes and Gender

Category of school	Boys'	Girls'	Mixed	Total
National	1	1	-	2
Extra-County	3	3	-	6
County	3	3	3	9
Sub-County	4	4	6	14
Total	11	11	9	31

Bungoma County has only two national schools, both of which participated in the study. Ten percent of schools from each of the remaining categories were sampled for the study. This enabled the selection of six Extra-County schools, Nine County, and fourteen Sub-County schools as shown in the table 1 above.

Sample Size

Table 2: Sample Size

Respondents	N	n	%	Type of sample
Teachers	350	70	20	Random

From table 2 above, it is evident that the sample size comprised of seventy (70) biology teachers drawn from the sampled thirty-one schools. Simple random sampling techniques were used to select the teachers. From the sampled Sub-county schools which have one or two streams, one teacher of biology was selected from each sampled school giving fourteen (14) teachers, four teachers were selected from National schools, amounting to eight teachers (8), four from each Extra-County school giving twenty (24) teachers, in six of the County schools, at least three teachers participated in the study while three of the County schools were represented by two teachers each giving a total of six teachers hence bringing the number of teachers from County schools to twenty four (24). Therefore, seventy teachers participated in the study, which constitutes 20% of the total number of biology teachers in the county.

6. Research Instruments and Data Collection

Data was gathered through biology teachers' questionnaire (BTQ) and an observation checklist. The questionnaire was the major tool utilized for data collection as it provided substantial benefits of administration. It also presented a uniform stimulus potentially to the increased numbers of people and at the same time offered the investigator with a simpler collection of information. The teachers' questionnaire contained six sections; Section A, had question items which sought to establish the teachers personal details while section B addressed the teachers belief about the nature of the subject and how it should be taught.

The observation schedule had a table with sections A and B. Section A sought information on the type of school and the number of streams, B; had a check list of resources and facilities within the school, against which the researcher determined their availability, and the frequency of usage.

7. Results and Discussion

Biology Teacher's Beliefs about Biology

The objective of the study was to identify the distribution of the teachers of biology in the three belief categories of pedagogical-innovative, scientific-innovative, and scientific-conventional types. The biology teachers' questionnaire required the respondents to indicate the belief category that under-pinned their understanding about the nature of biology and how it should be taught. This was to enable the researcher identify the distribution of the teachers of biology in the three belief categories as stated above. These belief categories that are specific to biology teachers were adopted from Neuhaus & Vogt, (2005). They describe what biology teachers believe about the nature of biology as a subject. The statements that corresponded to the three belief categories were as follows: Identification of the teachers to the specific belief category was based on the teachers' choice of any of the following description of the belief category.

1. Biology is a dynamic social science that deals with the study of living things; plants, animals, and micro-organisms. The subject emphasizes the social aspect of learning". This statement is in line with the first belief category of Pedagogical-Innovative.
2. Biology is a body of facts about plants, animals, and micro-organisms that can be proven through laboratory activities". This statement is in line with the second belief category of Scientific-Innovative.
3. Biology is a static unified body of knowledge and facts. It is an accumulation of facts and rules about animals, plants, and micro-organisms which need to be learned", this believe category is in line with the third belief category, the Scientific Conventional.

The three belief categories are important in determining whether the biology teacher may embrace new resources and technologies in the instruction and learning process or not.

The results show that, out of the seventy teachers of biology who participated in the study, (30.0 %), subscribed to the pedagogical-innovative, (57.1 %) to the scientific-innovative, and (12.9 %) to the scientific-conventional. From the responses of the teachers, their distribution in the three belief categories is presented in table 4.

Table 3: Respondents' Belief Category about Biology

Belief Category	Frequency	Percent
Pedagogical-Innovative	22	31.34
Scientific-Innovative	42	59.70
Scientific-Conventional	6	8.96
Total	70	100.0

The distribution of the respondents in the three belief categories indicates that most the teachers of biology subscribed to the scientific-innovative category. The teachers belonging to this belief category suppose that teaching authentic knowledge and laboratory activities is more significant, where as social attributes of learning is an issue of inferior importance. These teachers believe that facts can be proved or disapproved through experimentation. Hence teaching is an avenue for discovery of new knowledge through experimentation that can be used to falsify or prove the existence of certain phenomena.

The teachers who belong to the Pedagogical-Innovative category stress the social attributes of learning and instructing in biology. They further believed that links to everyday life is key during biology classes; and that teaching fundamental facts is less critical for them. They enjoyed attempting out innovative things in class. There is therefore continuous interaction between the learner, the teacher, and the classroom environment. The teacher adopts the responsibility of a facilitator as the learner constructs knowledge from the environment hence dynamism in the learning of biology. Teachers belonging to this category are willing to modify approaches and resources in the instructing and learning process. They are open to change and can incorporate new resources in the instruction and learning process. They are more receptive to the new technologies and embrace the emerging issues positively.

The least subscribed belief is the scientific conventional. Teachers belonging to the Scientific-Conventional type stress the importance of teaching biological facts. Biology as a subject is seen as a unified body of knowledge and facts about animals, plants, and micro-organisms. These teachers focus on the teaching of factual knowledge. For this group of teachers, neither research nor linking to everyday life are essential for the teaching of biology. The teachers assume the role of an instructor making the teaching/learning process to be teacher-centered rendering the learner to be a passive recipient of knowledge. Such an approach to teaching leads to low retention of knowledge as the learners' involvement in the learning process is minimal; Teachers who belong to this type of belief category are less eager to try new methods and topics. It is evident from the findings that the teachers who subscribe to this belief rarely integrate ICT in their teaching. Their frequency of usage of technology is very minimal.

8. Conclusion

Arising from the study, the distribution of the respondents in the three belief categories indicates that most of the teachers of biology subscribed to the scientific-innovative category (57.1%), followed by the pedagogical innovative (30.0%), while the least (12.9%) subscribed to the scientific conventional as identified by Neuhaus and Vogt. The study established that there is a significant relationship between the teachers who belonged to the three domain specific belief categories to the integration of technology. The belief category influenced the frequency of integration of ICT in biology instruction.

9. Recommendations

Basing on the three belief categories adopted by the study as identified by Neuhaus & Vogt, (2005), and subsequent distribution of teachers in each category, effective teaching/learning can be best achieved through the adoption of different ways of teaching emphasized in the three belief categories identified. In focus are the three belief categories of pedagogical- innovative, scientific-innovative and scientific- conventional towards improved teaching and learning. The study therefore recommends the integration of the practices attributed to each belief category for effective teaching and learning to be achieved in biology instruction in secondary schools.

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