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Effect of Context-Based and Conventional Teaching Approaches on Students' Achievement in Genetics

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ABSTRACT: *The purpose of the study was to investigate the effect of context-based and conventional approach in genetics. The explanatory sequential mixed-methods approach was used in this study. Multi-staged sampling was used to select the sample for the study. In all, 205 learners participated in the study. The experimental group (those taught with context-based approach) were 107 learners and the control group (those taught with the conventional approach) were 98 learners. Genetic content knowledge test (GCKT) and focus group interview were the instruments used to collect data for the study. The results indicate that students in the context-based approach outperformed those in the conventional approach. The experimental group's students seemed to like the teaching approaches adopted. However, the control group did not like the teaching method adopted. It is recommended that biology teachers teaching genetics must use context-based teaching approach since it has been proven to be effective in improving students' performance in genetics.*

KEYWORDS: context-based approach, conventional teaching, genetics achievement

INTRODUCTION

At all levels of education, the primary goal of teaching is to produce basic change in the student (Tebabal & Kahssay, 2011, Oladipo & Ayeni, 2000), as teachers have a direct impact on their students' learning (Abell, Appleton, & Hanuscin, 2010). To successfully change a learner, the teacher must transcend personal experience and enter the world of the students (Brown, 1997). There are numerous teaching strategies that are expected to aid the teacher in their effort to transform the students (Adufe, 2008). Teachers are supposed to employ the most effective instructional strategies that aid in the process of student transformation and information dissemination. Bhardwaj and Pal (2012) suggested that effective teaching approaches are those that are aligned with the needs of learners, as each learner understands and responds to situations and experiences uniquely.

Numerous teaching approaches and strategies have been created to ensure that teachers deliver successful instruction for students to grasp concepts easily and meaningfully (Ajewole, 1991). There are several ideologies that underpin the theories on which the instructional methodologies are based. Essentially, the various instructional styles fall into two basic categories. These are teacher-centered and student-centered approaches. The teacher-centered techniques are based on the theory of behavioural learning, which emphasises the importance of providing suitable stimuli that result in the expected and desired outcome in learners (Abell, Appleton, & Hanuscin, 2010). Students become passive to the teachers' instruction rather than actively engaging in the teaching and learning process. Student-centered approaches however, are based on constructivist ideas, which stress students' active participation in the building of their knowledge through interactions with their peers and as impacted by their experiences in the environment (Mir & Jain, 2015, Dhindsa, Makarimi-Kasim & Anderson, 2011, Nieswandt ,2001)

In the traditional epoch, many educators relied heavily on teacher-centered approaches to convey knowledge to pupils, as opposed to student-centered ones (Ganyaupfu, 2013). The traditional style of direct instruction has been criticised over the time for leading to students' disdain of science, owing to tedious presentations, excessive writing, insufficient practical activity, and an excessive amount of whole-class instruction in which students serve as passive recipients of information (Teo & Wong, 2000). However, in contemporary education, teachers are expected to do more than simply dump knowledge on students. As a result, teachers must aggressively encourage students to construct their own thoughts in their minds. This requires learners to gather information on their own, compare new information to previous knowledge, and change rules when they no longer apply (Ratanaroutal & Yutakom, 2006). The learner is considered as an active participant in the knowledge acquisition process. This is referred to as constructivism.

Concerns about the effectiveness of instructional approaches on student learning have constantly attracted educational researchers' interest (Hightower, 2010). Evidence points to the fact that science students' poor academic performance could be linked to teachers' use of inefficient ways of instruction to transfer knowledge to students (Adunola, 2011). Significant studies on the effectiveness of instructional approaches (Tebabal & Kahssay, 2011, Ayeni, 2011, Zeeb, 2004) reveal that the quality of instruction is frequently reflected in student accomplishment.

To be effective in teaching, Adunola (2011) asserts that teachers must be familiar with a variety of teaching strategies that take into account the extent of the complexity of the topics to be taught in order to produce desired changes in pupils. This means that the teacher is responsible for selecting appropriate teaching tactics and techniques to aid in the delivery of the subject matter and to aid learners' comprehension of the concepts presented by the teacher. Therefore, it is vital to employ proper teaching approaches and methodologies to effect desired changes in learners. Additionally, effective teaching approaches are those that cater for students' needs, as each learner perceives and reacts to questions uniquely (Bharadwaj & Pal, 2011; Chang, 2010). As a result, the alignment of instructional approaches with students' needs and preferred modes of learning has an effect on students' academic achievement (Zeeb, 2004).

Given that teaching methods are the primary approach used by teachers to accomplish lesson objectives (Borich, 2007; Fishburne & Hickson, 2001), teachers across all disciplines, including biology, utilise a variety of teaching methods to accomplish lesson objectives. To ensure that biology students reach their maximum potential in school, it would seem necessary for teachers to employ effective teaching approaches (Borich, 2007; Fishburne & Hickson, 2001). One of the effective teaching approaches that teachers can employ is context-based teaching. Beasley and Butler (2002) asserted that context-based teaching is a technique of instructing students in science in which the importance of the context or application of knowledge to a real-world scenario is stressed. When students need this knowledge in order to have a better comprehension of practical application, concepts are taught in this way. Similarly, context-based teaching approaches are built on the "need-to-know" concept, in which the context validates students' acquisition of biological principles from their own perspectives, making learning relevant on both an internal and extrinsic level (Beasley & Butler, 2002; Bulte, Westbroek, de Jong, & Pilot, 2006).

Statement of the Problem

According to the Ghanaian elective biology syllabus for senior high school, biology instruction should be student-centered and activity-based (Ministry of Education, 2010). Nonetheless, according to the Chief Examiners' Report, students underperform in genetics and biology in general (WAEC, 2007; WAEC, 2008; WAEC, 2009; WAEC, 2010; WAEC, 2011; WAEC 2012; WAEC 2013; WAEC, 2014; WAEC, 2015, WAEC, 2016, WAEC, 2017, WAEC, 2018). Ghanaian students' difficulties are not unique, as genetics has been highlighted as a difficult and abstract topic in which the processes involved are not physically evident (Abimbola, 1998; Locke & Mcdermid, 2005; Richards & Ponder, 1996; Ruiyong, 2004; Turney, 1995). Students demonstrated a lack of awareness of the mechanisms involved in the transmission of genetic information, as well as a lack of fundamental understanding of the structures involved, such as gene, chromosome, and cell (Marbach-Ad, 2001; Lewis & Wood-Robinson, 2000). Knippels, Waarlo, and Boersma (2000) discovered that students possessed a poor comprehension of the meiotic process and frequently confuse mitosis and meiosis. As a result, students develop a poor conceptual foundation for genetics.

Students' success in science has been linked in several studies to how scientific courses (such as biology and genetics) are taught (Onwu, 2009; Schwartz, 2006; King, 2007; Kyle, 2006; Van Aalsvoort, 2004). Mji and Makgato (2006), as well as Wilke (2003), found a connection between the difficulty of learning certain scientific subjects and inefficient teaching strategies. According to Van Aalsvoort, (2004), King (2007) and Kyle (2006), most genetics instructors use a teacher-centered approach. However, such strategies do not appear to improve students' conceptual understanding, hence impairing their achievement.

When genetics is taught through real life experiences and applications, however, students perform better (Bennett, 2003; Bennett & Holmann, 2002; Gilbert, 2006). Vogelzang, Admiraal, and Van Driel (2019) reaffirmed that when topics are presented in a real-world situation, science is supposed to become more engaging, relevant, and compelling for learners. Context-based teaching is one of the ways of connecting genetics to students' daily real-life experiences and applications (Podschuweit & Bernholt, 2018).

Although context-based teaching has been found to be efficient elsewhere (Kazeni, 2012), little research on it has been conducted in Ghana. This is unfortunate, given that there is substantial proof that a context-based approach can increase students' conceptual understanding and overall achievement. Given Ghanaian students' underperformance in genetics concepts, it would not be out of place to train them using context-based approaches to determine the sustainability of the approach in our educational system. This will establish the efficacy, or lack thereof, of context-based teaching approaches in increasing students' performance in genetics at the senior high school level in Ghana. This has therefore necessitated the need to investigate into the effect of context-based and conventional teaching approaches in genetics in Ghana.

Purpose of the Study

The purpose of the study was to investigate the effect of context-based and conventional teaching approaches in genetics.

Research Questions

1. What is the difference in performance between students taught with context-based teaching and those taught with the conventional approach in genetics?
2. What are students' views on features of the context-based and conventional teaching approaches that could account for differences, if any, in student performance in genetics?

LITERATURE REVIEW

Context-based Teaching

Numerous nations are experimenting with context-based teaching techniques in attempt to reinvigorate scientific education and foster the development of new lively learning environments that meet the different demands of students, society, and science (Osbourn & Dillon, 2008). The fascination with context-based education arises from the fact that it addresses a multitude of issues afflicting global scientific education (Lyons, 2006). School science curriculum are often filled with isolated facts, the majority of which are generated from a conceptual application of science that bears little or no connection to the learners' lives (Gilbert, 2006). Learners commonly express dissatisfaction with their science learning environment due to a lack of relevance and a high level of theoretical complexity. The complaints about science learning have resulted in many educators becoming interested in context-based science education (De Jong, 2015; Meijer, Bulte, & Pilot, 2013; Millar, 2007; Roehrig, Kruse, & Kern, 2007; Sevian & Bulte, 2015; Sevian & Talanquer, 2014; Sjöström & Talanquer, 2014; Tytler, 2007).

Numerous definitions exist for context-based instruction. "Context-based techniques are those employed in science education that begin with the contexts and applications of science" (Bennett, Lubben, & Hogarth, 2007, 348). Context-based approach is the application of science with the goal of increasing students' scientific knowledge of their real-world contexts while also strengthening their ability to function as responsible members of society (Beatty & Schweingruber, 2017, King, 2012; Aikenhead, 2006; Bennett, 2005). At the core of context-based learning is the enticing relationship between real-world context and scientific learning, called the 'need-to-know principle' (Pilot & Bulte, 2006; King, 2012). Authentic assignments contain real-world problems and can be used to integrate abilities in relevant settings (Baker, O'Neil, & Linn, 1994: 335). In this study, context-based teaching is defined as the development of science concepts and skills from situations of daily life experiences with which students themselves are familiar and perceive as relevant.

De Jong (2008) identified four areas as context-rich. Personal, social and society, professional activity, and science and technology all fall under this category. In De Jong's opinion, the following are relevant domains:

1. Health and needs are included in the personal domain since they are relevant to the learners' own lives (food, clothing).
2. Social and environmental challenges such as crime, climate change, and acid rain effect are addressed in the social and societal domain.

3. The professional practice domain contains work-related situations.
4. The scientific and technical domains are those concerned with scientific and technological discoveries and advances.

Contemporary educational settings face a variety of challenges (Roelofs, Visser, & Terwel, 2003), which include:

1. construction of knowledge versus transfer of knowledge;
2. learning in settings involving a single task as opposed to situations involving several tasks;
3. emphasize on individual understanding as opposed to teacher-led meaning;
4. professional or scientific contexts versus formal school/education contexts;
5. collaboration and communication versus self-study.

Students' participation in actual scientific procedures is commonly overshadowed in school science learning environments, which emphasize the exhibition of 'a stack of fixed results' (Osborne, 2007). Even when a scientific procedure is described, it is usually taught to students rather than experts and is often oversimplified as a consequence (McComas, 1996; Kessels & Taconis, 2012). In addition, science instructors usually show a lack of knowledge about scientific careers (Osborne & Dillon, 2008). To solve these difficulties, context-based education utilises contexts as the foundation for curriculum creation and classroom instruction (Pilot & Bulte, 2006). By relating to everyday economic and social realities and difficulties, contexts give clarity, connectivity, meaning, and relevance. This typically results in integral tasks that span numerous lessons, rather than discrete activities as in more traditional lessons. Additionally, context-based instruction supports students' engagement in scientific thinking and activity, increasing students' knowledge of science's fundamental principles and preparing them for future careers (Schwartz, Lederman & Crawford, 2004).

Context-based teaching's core tenet is that real-world context offers meaning and context for the science concepts and ideas discussed in science lessons. Context-based education assists students' efforts to grasp their world by arming them with scientific information and skills that aid the development of greater comprehension. Learning science is made more meaningful and valuable when it is launched off on a real and demanding setting, according to one school of thought (Gilbert, Bulte, & Pilot, 2011). This applies to both practices and results. Context-based instruction's most important element is the use of authentic context as a springboard and basis for scientific learning, giving science information meaning and purpose. This necessitates that the context to establish "a coherent structural meaning for something novel placed inside a broader context" (Gilbert, 2006, p. 960). For students, a context should be meaningful and recognized. In the classroom, contexts are created using real-world or scientifically correct scenarios and activities (Gilbert, 2006). Secondary features include increased space for learners to make choices for their own education, a stronger focus on discussion and cooperation, as well as on the method and nature of science. Contexts and their utilization must meet certain characteristics in order to be effective. Contexts that are appropriate must bring "a cohesive structural meaning for something novel that is situated within a broader context" (Gilbert, 2006). Future learning is guided by the context and a specific issue or 'focal event' inside it. Contexts should have the following characteristics:

1. a situation in which people's minds are drawn to important occurrence
2. a psychological setting in which the encounters occur
3. ways of framing subsequent talk around the focus event's task(s)
4. the use of particular language as the subsequent talk linked with the focal event occurs; and
5. a link to non-situational background information (Gilbert, 2006).

It is essential that settings are identifiable, intelligible, relevant, meaningful, and motivating to students, as well as connected to past knowledge (Gilbert, Bulte & Pilot, 2011). Daily life situations, actual scientific or scientific contexts and operations, as well as societal dilemmas and debates, are all suitable examples (Gilbert, 2006). Furthermore, context-based learning environments must have a regulated and productive 'behavioral environment' that supports or stimulates conversation targeted at comprehending creativity (Gilbert et al., 2011).

Context-based Teaching Approach and Conceptual Understanding

Context-based teaching has been shown to be inconsistently successful in developing learners' conceptual understanding. Students exposed to context-based teaching had more conceptual comprehension than students exposed to conventional instruction, according to Gutwill-Wise (2001), Bloom and Harpin (2003), Yager and Weld (1999), and Sutman and Bruce (1992). Ahmad and Eli (2018) investigated the influence of context-based teaching on the attitude of students and their success toward acid-base material and discovered that context-based chemistry learning improved student achievement and attitudes. The research conducted by Eshetu and Assefa (2019) on the impact of teacher-selected context-based instructional techniques on students' problem solving -ability to solve problems in rotational motion revealed that context-based instructional techniques are statistically substantially more effective at improving students' problem-solving abilities than conventional approach. Bloom and Harpin (2003) required teachers to choose their own context while generating context-based materials in their study on context-based teaching. They discovered in their study that students exposed to context-based instruction attained a higher level of conceptual understanding than students subjected to standard instruction.

Magwilang (2016) used a pre-test-posttest control group design to perform experimental research with 96 students from two inorganic chemistry courses. The experimental group was exposed to acidic and basic substances derived from context-based materials Academic attainment was substantially higher in the treatment relative to the control group. As a result, the study found that context-based learning boosted students' acid and base achievement levels. According to Bennett and Lubben (2006), learners who responded to the context-based technique attained a comparable degree of comprehension of chemical principles to those who took more conventional courses. Context-based techniques improves how students understand concepts, motivation, and retention (Murphy & Whitelegg, 2006). Ramsden (1997) assessed students' results on a variety of assessment tasks in high school chemistry using both a context-based and the conventional method. While there is no difference in students' levels of learning, the study showed that a context-based approach appears to have some benefits with regards to enhancing the enthusiasm of learners in science.

According to Gutwill-Wise (2001), students who were taught chemistry using the context-based method performed better than similar students who were taught using the conventional/traditional approach. The findings suggested that learners exposed to the context-based method had a greater comprehension of chemistry than their colleagues exposed to the traditional technique in both institutions. Özay-Köse and Çam-Tosun (2013) investigated the impact of context-based learning strategies on learners' success and scientific process skills while teaching biology. The findings indicated a considerable impact between context-based and conventional learning with regards to students' performance and ability to perform scientific processes.

According to Esra and Figen (2015), a context-based approach to biology improved learners' performance and attitudes. They contended that contexts help students' biology learning because they are narratives tied to their everyday lives. Students are more receptive to stories, and stories are easier to remember. Students should recall the story, consider the principles contained inside, and make connections to other concepts. Additionally, teamwork, discussion, and research assist in effectively structuring knowledge (Esra & Figen, 2015). The context-based approach was successfully implemented in a number of university-level control engineering courses, with particularly positive results with respect to students' learning performance (Dong, 2005). Murphy, Lunn, and Jones (2006) contrasted 53 high school learners who studied about radioactive elements in real-world situations such as radiation and health, radioactive waste, and power generation against 81 learners who received conventional physics teaching on a typical physics assessment. The researchers discovered that learners in the experimental group increased their performance far beyond learners in the conventional group between pre- and post-test. Kutu and Sözbilir (2011) discovered that context-based teaching has a favorable influence on students' achievement in their study, similar to research conducted by (Bennett & Lubben, 2006). However, there are some studies that demonstrate a contrary finding for conceptual comprehension, the students exposed to either a context-based approach or a conventional technique showed no significant changes, as observed by Tasoobshirazi and Carr (2008). Others researchers reported no statistically significant variations in the conceptual understanding of the two groups of learners (Bennett & Holmann, 2002: Barber, 2001; Ramsden, 1997: Barker & Millar, 1996). These inconsistencies discovered in context-based research may be a result of differences in the design and delivery of teaching materials. In their synthesis of research evidence, Bennett et al. (2006) found a dearth of studies on the effects of context-based and Science, Technology, and Society - STS approaches to science teaching, and these studies were unable to state unequivocally or definitively the influence of context-base on conceptual understanding. As a consequence, it is hard to make definitive claims about the impact of context-based instruction on students' conceptual understanding of biological concepts. There is every indication that further study is needed in context-based teaching, particularly in countries and settings where it has not been widely used.

Conventional Teaching Approach of Science

The conventional teaching approach is a kind of teaching in which students only absorb knowledge from the teacher without developing an interest in the subject being taught (Boud & Feletti, 1999). This is the least practical, most theoretical strategy available, and results in memorisation (Teo & Wong, 2000). Due to the teacher's control over knowledge transfer and dissemination, the teacher may attempt to maximize information delivery while minimizing time and effort. As a result, students' concentration and understanding may suffer. (Teo & Wong, 2000). The evidence indicates that traditional methods of teaching science frequently fall short of adequately developing students' knowledge of scientific topics (Allen, 2008; Taasoobshirazi & Carr, 2008; Wilke, 2003). This may be explained by the fact that teachers simply relay information to pupils and therefore maintain complete control of the session. Taasoobshirazi and Carr (2008) stressed that studies have shown that conventional techniques of teaching science, such as memorizing and computations, usually lead to students not being able to comprehend the deeper conceptual links inside issues. This method of instruction promotes ineffective problem-solving strategies and inadequate grasp of newly acquired concepts and ideas. To overcome these deficiencies, Zakaria, Chin, and Daud (2010) argued that teaching should not merely center on imparting rules, definitions, and procedures for students to understand, but should also actively involve students as key players. There is a strong focus on "chalk and talk" education in high school science, and students copy notes, acquire facts as well as abstract ideas and "cookbook" practical demonstrations (Osborne & Collins, 2001)

Teachers in certain high school science classrooms have been reported to provide examples or answer issues on the board and to perform experiments in some cases (Kang & Wallace, 2005; Briscoe & Prayaga, 2004). Students are required to pay attention and take notes in these sessions, but they are seldom encouraged to ask questions or offer observations. Lyons (2006) found that the transfer of information from expert sources (teachers and text materials) to mostly passive receivers occurred throughout high school scientific instruction (the learners).

Conventional teaching approach and conceptual understanding of genetics

Genetics is a challenging and complex subject, because the processes at work are not physically evident (Locke & Mcdermid, 2005; Ruiyong, 2004). As a result, many students struggle with genetics. Many factors contribute to the difficulty of learning genetics and genetics-related concepts, such as the prevalence of misconceptions (Cimer, 2012), domain-specific vocabulary and terminology, and problems requiring application and reasoning skills, as well as instructional approaches that do not promote meaningful learning (Ibanez-Orcajo & Martinez-Aznar, 2005; Dogru-Atay & Tekkaya, 2008; Lewis & Kattmann, 2004). Wilke (2003) asserted that ineffective teaching techniques have been blamed for the difficulties in some areas of biology, such as genetics. This assertion was also stressed by Seymour and Hewitt, (1996) and Sundberg, Dini and Li (1994). In an effort to improve performance, researchers have looked at many teaching approaches, including those that take place outside of the traditional classroom, collaborative activities, socio-cognitive techniques, and problem-based learning (Dairianathan & Subramaniam, 2011). Using these strategies, the primary goal is to make genetics instruction more relevant for students and to help them get a better conceptual understanding of the topic.

The Theoretical Framework of the Study

A large portion of the theoretical framework for this research came from Hung's (2006) 3C3R model for developing challenges in problem-based learning (the 3Cs are content, context, and connections and the 3Rs are reasoning, reflecting and researching). The 3C3R model is made up of two main classes of components: core and processing. The three primary components are content, context, and connection, and they all work together to facilitate the acquisition of material/concepts. The processing components include researching, reasoning, and reflecting, which all contribute to an understanding of the learners' cognitive processes and problem-solving abilities. The 3C3R model was used for this research; it consists of two types of components: core components and process components.

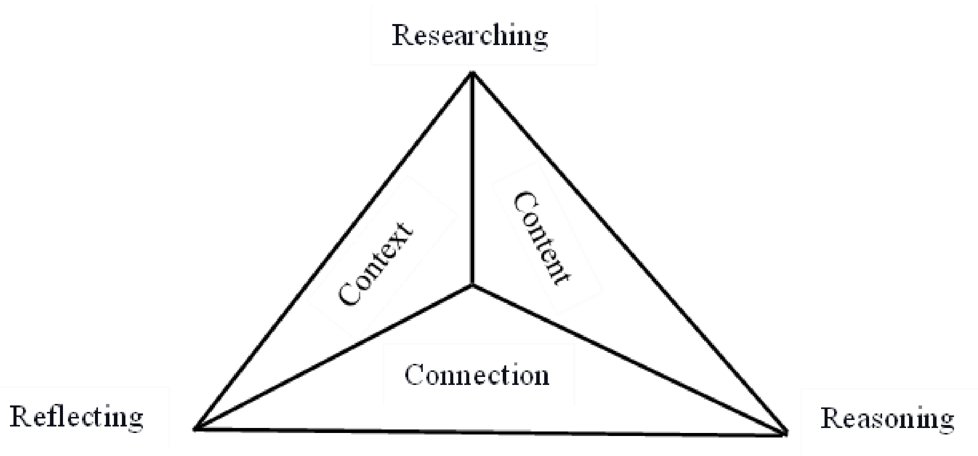

Figure 1: The Hung Model for Problem-Based Learning Design (Hung, 2006, p 57-65)

The core component comprised the genetics content knowledge taught, the contexts used in teaching the content material, and the connections or linkages made between the content and contexts. This component may be considered as underpinned by a situated learning framework (Brown, Collins, & Duguid, 1989). The process component was about the teaching and learning activities', mostly done through critical discussions, arguments, debates, practical investigations and is seen as forming part of the cultural dialectics of the science classroom in the tradition of social constructivism (Solomon, 1987).

METHODOLOGY

Research Design

The explanatory sequential mixed-methods approach (Creswell & Plano Clark, 2011) was used in this study. The explanatory sequential mixed-methods approach entails collecting and analysing quantitative data first, followed by qualitative data gathering and analysis to provide further explanation to the quantitative results (Creswell & Plano Clark, 2011). A non-equivalent pre-test-post-test control group quasi experimental design was used for the study's quantitative component. A focus group discussion was utilized to gather qualitative data from students about their thoughts and opinions on the intervention as part of the qualitative research technique.

The participants in this research were all Ghanaian third-year public senior high school science students. The third-year public senior high school science students were used because genetics is a third-year topic so it is believed that they have been taken through prerequisite topic like cell biology in the first year of their course.

Multi-staged sampling was employed. One region was selected from the 16 regions in Ghana using simple random sampling. In the Eastern region, purposive sampling was used to select schools that offer general science programme. Six senior high science schools in the eastern region were simple randomly selected to take part in the study. These science schools were schools with more than one science class. The science schools were selected because science schools offer their students a General Science programme where students learn biology as one of the elective subjects. A third-year science class was selected by simple random sampling from each of the participating schools. This was because all the selected schools have more than one science class. Thus, six classes from six different science schools were selected using simple random sampling. To represent the experimental group, three classes were selected using simple random sampling. The control group was automatically assigned to the remaining three classes. In all, 205 learners participated in the study. The experimental group (those taught with context-based approach) were 107 learners and the control group (those taught with the conventional approach) were 98 learners.

Data Collection Instruments

This research made use of two different instruments. These are the genetic content knowledge test (GCKT) which was used for the pretest and posttest, and focus group interview. The GCKT was used to determine the influence of context-based instruction on biology students' genetics success. The focus group discussion elicited information on students' view of the context- based teaching approach and gave further explanation to the quantitative data obtained.

RESULTS AND DISCUSSION

Research question one sought to examine the difference in genetic achievement of students taught with context-based approach and those taught with the conventional approach. To examine if the two groups fared similarly on the pre-test, an independent sample t-test was utilized. The results of the independent sample t-test on the pre-test scores are shown in Table 1.

Table 1: Results of independent sample t-test on the pre-test scores between students taught with context-based approach and those taught with the conventional approach in genetics.

Teaching approach	N	Mean	SD	df	t	*p*
Context-based approach	107	8.78	10.689	203	.940	.349
Conventional approach	98	7.71	4.513			

The pre-test scores between context-based approach (M=8.78, SD=10.689) and conventional approach (M=7.71, SD=4.513; t (203) =0.940, p>.005) using independent-sample t-test showed no statistically significant difference. This means that the students from the two groups (context-based and conventional approaches) were performing at the same level before the intervention was implemented. This situation provides a good justification for comparing students' posttest results in the context-based and conventional approach. Table 2 shows the results of the independent sample t-test (posttest) in genetics comparing students' performance in context-based approach and conventional approach.

Table 2: Results of independent sample t-test (posttest) between students taught with context-based approach and those taught with the conventional approach in genetics.

Teaching approach	N	Mean	SD	df	t	*p*
Context-based	107	33.28	10.892	203	11.563	0.001
Conventional approach	98	16.87	9.275			

The posttest scores of context-based approach in genetics (M=33.28, SD=10.892) differed significantly from the conventional approach [M=16.87, SD=9.275; t (203) =11.563, p= .001]. A comparison of mean scores suggests that students in the context-based approach outperformed those in the conventional approach, and the difference in performance was significant. The magnitudes of the mean differences were very large (eta squared=0.60) (Cohen, 1988).

This research found that students exposed to context-based approach had considerably superior content understanding of genetics than students exposed to the conventional approach. Using context-based teaching approach greatly improves learners' mastery of genetics content knowledge, problem-solving and decision-making capabilities, and the capacity to generate hypotheses. This study's findings back up Kazeni's (2012) findings and Avargil, S. et.al (2018).

The differences in the performance of the learners could be attributed to the methods used in teaching the students. Since the students in the context-based group (experimental group) were taught with familiar contexts, their performance improved. Literature shows that when instructors concentrate their advance organizers on the most important topics for students rather than on what they assume would be the most interesting, pupils invariably perform well (Kulkowich & Schulz, 1994; Risner, Nicholson, & Webb, 1994). Students in the experimental group were more inclined to study genetics because of the relevance of the specified settings to their everyday lives. This resulted in better academic achievement. Lessons that contain personal meaningful applications of science boost learners' attention and involvement in scientific lessons (Lubben and Campbell, 2000). As a consequence, Whitelegg and Parry (1999) believed that context-based education empowers students to negotiate the learning process such that it satisfies their social needs by using situations that are accessible or applicable to them.

It is also possible that using narratives based on realistic (real-life) circumstances might have improved learner performance in the students' selected context (Gilbert, 2006). It was possible for the teacher to begin classes using what the students already knew and had experienced. As a result, the teacher is able to combine the socially acceptable characteristics of a setting with the properties of a context that learners are acquainted with. Incorporating real-life storylines can help students better understand why genetics is important, allowing them to build knowledge and apply it in new situations (Van Oers, 1998). The use of the real-life narratives also created learning environment that was conducive for effective learning.

The control group that was taught using the conventional approach did not appear to be familiar with the learning materials and were not able to relate with them. This is because teachers mostly employ materials set by the curriculum and textbooks, which accounts for this (Bennett & Holmann, 2002). As a result of this, learners are not able to relate to the learning materials. The comments of the students as seen in the focus group discussion show that they found some aspects of genetics difficult to understand due to the fact that the concepts appear abstract and unrelated to their experiences. For example, “genetics can be relevant if we talk about things which we can see, not just things we imagine in our minds” as stressed by Kwame. Koliko said that “what made genetics difficult is that we can’t see what we are learning about”. Kutus asserted that “I see genetics to be difficult because it is abstract and I am not able to apply what we learn outside the classroom”.

Student underperformance in the conventional approach was not unexpected, since according to Dogru-Atay and Tekkaya (2008), learners' performance is hampered when they do not recognize the connection of the content they are learning to their everyday life. This statement was confirmed by Ibanez-Orcajo and Martnez-Aznar (2005); Lewis and Kattman, (2004). Students in such a situation do not see the need to learn and fail to see the significance of the concepts being taught. Such perception leads students to at best undertake rote learning and at worst fail to grasp concepts being taught. There is no meaningful learning occurring either way which is detrimental to the future learning of students and application of concepts being taught. Research question two sought to find out the views of students on features of the context-based and conventional teaching approaches that could account for differences, if any, in student performance in genetics.

The Perspectives of Students on the Teaching Methods Employed in Genetics

The experimental group's students seemed to like the teaching approaches adopted. They attributed their likeness for the methods used due to the use of practical activities and stories relating to their real-life experiences. Felix noted that "the teacher began with stories relating to our everyday life. This made us more interested in what he was teaching us. After the teaching, he gave us more stories relating to our lives on what he taught us and this made us understood the lesson very well". John felt he enjoyed the practical activities and the story the teacher used enabled him follow the lesson. He argued that "the story sustained our interest and we wanted to know more". Stephen observed that "some teachers are too lazy to explain to learners what is happening. They just give you notes from the textbook or tell you to go home and read from page 56, and tell you to explain what you read to the class. It was difficult to understand. But the method used in the lesson was not like that. We understood what we were learning". Kofi noted that the teacher began with stories relating to our everyday life. This made us more interested in what he was teaching us. After the teaching, he gave us more stories relating to our lives on what he taught us and this made us understood the lesson very well. Yidara also said that "when sir started with the story, I enjoyed the lesson so much. Sir also gave us more stories after teaching us and that made us understand the topic very well". This remark by the students is consistent with Aikenhead (1992), who said that STS curriculum follows a constructivist approach, one of which is context-based teaching. These use simulations, small group work, group discussions, debates, problem solving, decision making, role acting, divergent thinking, or the media and other community resources to include cooperative learning, peer support, issue-based methodologies, and related knowledge (Solomon, 1993; Byrne and Johnstone, 1988). It fosters student engagement, increases student motivation and attitude development, and hence performance (Byrne and Johnstone, 1988).

The control group appeared not to like the teaching methods used. The following were some of the responses learners in the conventional group gave when they were asked about their perspectives of the teaching methods employed in genetics. Samuel noted that "The way our teacher taught us looked abstract and we could not understand it". This assertion was confirmed by Philip who stated that "the lesson was boring and we didn't understand it".

CONCLUSIONS

The purpose of the study was to investigate the effect of context-based and conventional approach in genetics. The results from the study indicates that context-based teaching approach used in this study improved students' performance in genetics than the conventional approach.

Recommendations

Biology teachers teaching genetics must use context-based teaching approach since it has been proven to be effective in improving students' performance in genetics. In addition, regular workshops and in-service training should be organized for biology teachers on the effective use of context-based teaching approach in order to improve the performance of students in genetics. There are several approaches to context-based teaching but this current study did not look at that. It is therefore recommended that further studies should look at the various approaches and their effects on students' performance in genetics.

Possible Contributions of the Study to Academic Knowledge

It appears from a review of the literature that not much studies have been carried out on context-based teaching in genetics in Ghana. This study therefore seeks to address this.

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