



Using Generative Artificial Intelligence to Design a College Environmental Science Course

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ABSTRACT

This paper briefly looked at the importance, objectives of chemistry education in Nigeria. However, several factors have been also identified to have bedeviled the proper delivery of chemical knowledge at all levels of our educational system in Nigeria, these include agriculture, healthcare, potable water supply, clothing, energy supply. The paper discusses further the objectives of chemistry education in Nigeria, contributions of chemistry education to national development, the importance of chemistry education, the role of chemistry education in national development, role of chemistry education in wealth creation, waste management and wealth creation. In view of this, it was concluded that chemistry education enhances skill acquisition and application propagation of the teaching and learning of chemistry and empowers students by exposing them to entrepreneurship programmes in which they can make choices in life and become self-employed.

1. Introduction

The educational process includes methods and techniques that provided the students the basic information in a way that helps them embrace it as easily as possible, facilitate the direct access of the students to different sources and stimulate creativity and teamwork (Pop-pacurar & Tirla, 2009). They define learning of science is essential in every educational system that aims to prepare citizens of one's nation for a productive life. In this regard, science education occupies a key position in the school curriculum of Ethiopia.

“Science is very essential for the development of technology, which served as a motor for our changing world. Therefore, students must understand science concepts. Because they can solve their problem as well as the problem of the world. Mostly, science teachers in the classroom teaching science by using the lecture method are less likely achieved the desired objective. The main purpose of the science courses must be training students to acquire the required learning skills and beliefs towards learning and scientific knowledge to develop a capacity to think scientifically, to analyze critically, daily life, and to integrate theory and practice. Moreover, science courses must be designed with the consideration that learning consists of iterative interactions that take place between students' existing conceptions and their new experiences (Temitope & Deborah, 2015)”.

Most of the time, model-based teaching is an instructional practice where students explore content by using models and is used extensively in the areas of mathematics and science. Students are at the center of the learning experience and take ownership of their own learning (Gabel & Gabel, 2018).

The study that shows the importance of teaching by using models have great value in teaching biology students to explore biological objects and phenomena that inflexible to perceive directly and they can easily to understand the science concepts (Mclachlan, 2003). According to Chittleborough and Treagust, (2009), models are often seen as teaching tools that enhance the visualization of abstract concepts.

Similarly, Loucaand & Zacharia, (2011), modeling-based learning is an approach for teaching and learning in science whereby learning takes place via student construction of models as representations of physical phenomena that include representations of physical objects and their characteristics, physical entities and physical processes involved in the physical phenomena. This leads to an externalized representation of the underlying mechanism of a physical phenomenon and helps learners build an understanding of that mechanism. Different researchers define modes in different ways. According to Mclachlan (2003), the study that shows the importance of teaching by using models has great value in teaching biology, it directs students to explore biological objects and phenomena that inflexible to perceive directly and the can easy to understand the science concepts. Models divided into two kinds such as structure models and process models. The structure models may be a representation of structures which are physical, mathematical or computer-generated forms. Such structure models enable us to visualize the inaccessible. A structure model should represent the phenomenon under investigation as closely as possible. A process model allows us to experiment on the inaccessible, to explore the consequences of changes or manipulations which in the real world may not be possible for practical or ethical reasons. Structure models help us see how something is made, while process models help us understand how something works. Structure models empower

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thinking by analogy, while process models empower thinking by analysis.

Similarly, Skjold (2012), a study model is an illustration or explanation of the phenomenon with features that are considered important. Models allow for multiple representations including physical or structural, functional and analogical. Mental models are implicit and not visible to others except through expression in external representations such as conceptual models. Conceptual models, on the other hand, are the explicit representations that allow the science phenomena in question to be more understandable and predictable for students. These explicit representations include graphs, computer simulations, diagrams, analogies, mathematical equations, and physical models. The presence of teaching models in teaching-learning biology classroom strongly supports the process of delivering information from teacher to students. The complex biological phenomenon can be easily explained to students such as human anatomy.

1.1 Conceptual Framework

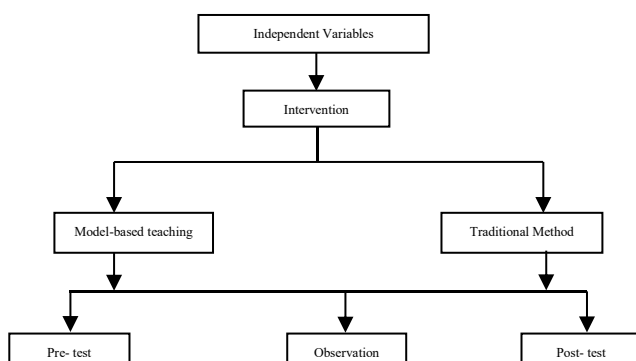
A conceptual framework is defined as a network or a “plane” of linked concepts. Conceptual framework analysis offers a procedure of theorization for building conceptual frameworks based on the grounded theory method (Jabareen, 2009).

The present study has two main variables. They are explained by categorizing as independent variables and dependent variables.

1.1.1 Independent Variables

Independent variables of the study were the received treatment. The treatment was the mode of instruction namely, model-based teaching approach and traditional teaching approach. The instructions applied on human skeletal system. On the other hand, times consists of three levels in the analysis of conceptual understanding measurements as time1, time2 and time3. At time1, which corresponds to the beginning of the instruction for each topic, measure understanding level of groups as at pre-test implementation, students were at the onset of the treatment were administered to be able to compare the experimental and control groups prior scores in terms of collective variables and examine the change in their scores during the study . At time2, corresponds to during intervention students assessed classroom observation, conceptual understanding about the topic, their participation, interests, identify misconceptions and fill learning gap of students and all students were instructed human skeletal systems were administered to investigate the effect of treatment. At time 3 which corresponds to the end of the instruction for each topic, related conceptual understanding were, treatment was completed ,evaluate the effect of treatments as post-test and related variables. The conceptual framework of the research is given as follows:

Figure 1 Conceptual framework of the research



1.1.2 Dependent Variables

Dependent variables of this study were improved the students' conceptual understanding on the unit of human skeletal system (i.e., structure and functions of skeletal system, bones, bone marrow, tissue, joints and tendons). Students' conceptual understanding in the unit of human skeletal system was measured by pre-test, post-test and classroom observation. Teaching by using MBT approach is more effective than traditional once. Student conceptual understandings were improved, increased their participations, interests, clear their misconceptions and fill the gaps of learning difficulties.

1.2 Research Questions

1.Is there a significant difference between context-based teaching approach and lecture method teaching approach when they thought human anatomy?

2.What is the effect of context-based biology instruction on students' conceptual understanding of human anatomy?

3.What is the interaction of students when they taught by context-based teaching approach?

1.3 The Aim of the study

The main objective of this study is to improve students' conceptual understanding of human anatomy by using model-based instructional approach in grade seven students. Specifically, the study was designed to identify the significant difference between the traditional teaching approach and model-based teaching approach, to assess the effect of model-based biology instruction on students' conceptual understanding of human anatomy and to observe the interaction of students when they taught by model-based teaching approach.

1.4 Students' misconceptions about human anatomy

Many studies have attempted to gain a perspective on students' conceptual understanding of human body systems. The studies have shown that students do not fully understand the major concepts of human body systems and have knowledge deficiencies, misunderstanding, and difficulty to interpret the subject. For example, according to Reiss & Tunnicliffe (2001), most of the primary school students challenging to understanding the concepts of the human body because the concepts are complex and the internal organs are baffled. For instance, students know that they have bones, but they cannot indicate specifically to show by drawing. Other scholars James et al. (2007), students may struggle with these human anatomy topics based on the following common misconceptions: Humans may only use one or a few organ systems for each activity they do (when, in fact, almost all human body systems are at work constantly); bones are not living tissues because of their solid, rock-like appearance (when, in fact, they contain cells, blood vessels, and marrow); and muscles push on bones when, in fact, muscles don't move bones directly they contract, pulling on tendons, which attach muscles to bones, and the bones move).

Considering the skeletal system concept, the study conducted by Caravita & Falchetti (2005), implied the perception of students regarding the bones; if the bones of a living organism are also living or non-living. The data were collected from 189 students ranged in age from 7 to 12 years who visited the Civic Zoological Museum. Each student was interviewed with the following questions: Are bones alive when they are inside the living body? What evidence do you have to this effect? What are bones made of? Can bones grow? How do

they grow? And do children or newborn animals have the same bones as adults? The answers of students especially in secondary school level indicated a large frequency of the nonliving statement towards bones. Moreover, students who stated bones as alive mostly failed to express acceptable criteria to justify their answers. Rather, they argued the movement of bones or the presence of bone components like marrow as a criterion. These justification criteria were also observed a student who states the bones as not alive but in an opposite way. They explained, for example, bones are not alive because they cannot move.

1.5 Teaching methods

The term teaching method refers to the general principles, pedagogy and management strategies used for classroom instruction. Teaching methods in the process of knowledge formation, the traditional teaching method and active learning pedagogies approaches are two major types of teaching approaches (Kolesnikova, 2016).

1.5.1 Traditional teaching approaches

In the context of this study, 'traditional teaching approaches' refer to the usual methods used by educators to teach science subjects. According to Kolesnikova (2016), the traditional teaching method, also known as the lecture method is very common in education. Based on this lecture method, the educator can deliver the message via the "chalk-and-talk" method. The traditional teaching method in schools is the teacher focus on the transfer of knowledge from the teacher to the student while students are a passive listener, traditional teaching methods are challenged for students inability to foster critical thinking, holistic learning environment among children (Ivić et al., 2016). Similarly (Richardson, n.d.), the traditional approach of teaching is the transmission model that promotes the traditional approach of teaching is the transmission model there is no interaction between prior and new knowledge. The information acquired from traditional teaching, if acquired at all, is usually not well integrated with other knowledge held by the students. Thus, new knowledge is often only brought forth for school-like activities such as exams and ignored at all other times. Traditional way of teaching encourages poor conceptual understanding and limited comprehension of learned in science concepts and ideas.

1.5.2 Student-center teaching approach

Teachers must be responsible for the processes through which students obtain new knowledge. As (Mathias, 2014, Miller, McNear, & Metz, 2013), states that active learning is a student-centered teaching technique that uses various interactive, multimodal strategies to create a more engaging classroom setting compared with the traditional didactic lecture. Active learning is an instructional method that engages students in the learning process. Students are more engaged in the learning process and increasing understanding. The active learning format allows misconceptions to come up naturally in the learning process and students can recognize the mistakes they made and correct them which lead to better retention of the material and a deeper understanding. This approach moves the classroom from a teacher-centered to a more student-centered model; teachings must have to be responsive for the processes through which students obtain new knowledge.

In addition to Fernando & Marikar (2017), active teaching advocates a participatory approach in which students actively

participate in the learning process, emphasize that the active construction of knowledge by the learner. In modern teaching strategies focus on encouraging students in the teaching learning process such as problem-solving, constructing knowledge, interpreting ideas, and sharing on the information. Similarly, Ivić et al., (2016), the teacher considers students as partners and therefore determines teaching strategies, ensures different approaches to information and provides help in acquiring new teaching contents. In such an environment, students take over the responsibility for learning, actively seek knowledge, construct it and give it meaning.

2. Research design

This study was conducted as design-based research. Design-based research "is a systematic study of designing, developing and evaluating educational interventions." In this study were used a quasi-experimental design of the study through the application of using experimental groups and control groups. All the two groups were taken a pre-test, post-test and observations were made. The experimental group has received the interventions of a model-based teaching approach, while the control groups with the traditional teaching approach as a control variable. The collected data by using both qualitative and quantitative data collection instruments were used a pre-test, post-test and classroom observations.

2.1 Source of data

In order to investigate this research the researcher collected the relevant source from Ewketfana primary school grade 7 students by different data gathering techniques.

2.2 Population of the study

The populations of this study were grade 7 students in Ewket fana primary school in the academic years of 2011 E.C. The total population is 260 students. The participant of this study was two sections of grade seven students out of four sections. The researcher chooses for grade 7 students because, human anatomy concepts start at grade seven level.

Table 1: Population size

Name of school	Number of students			
	Sections	M	F	Total
Ewket fana primary school	A	33	29	62
	B	28	38	66
	C	29	37	66
	D	27	39	66
	Total	117	143	260

2.3 Sample size and sample techniques

Ewket fana primary school students were taken as a target population of this study. Two sections from grade seven were selected by using simple random sampling techniques out of four sections. Based on this data, the researcher selected two sections(C&D) and grouped into two (the experimental group and the control group). The samples that were used for the purpose of this study composed of 132 students.

Table 2: Samples size

Name of school	Groups	Numbers of students		
		M	F	Total
Ewket fana primary school	Experimental	29	37	66
	Control	27	39	66
	Total	56	76	132

2.4 Intervention

This intervention was conducted for three weeks. The intervention program consisted of three phases these are: Firstly, the researcher was started given by the pre-test to learners in order to determine homogeneity in their knowledge of the topic, about 'Human Anatomy'. Secondly, the intervention was conducted after the administration of the pre-test for three weeks. The experimental group was taught by using the model-based teaching approach for the topic of human skeletal system concepts. At this time, lesson plan was applied by using 5E instructional design model while the control groups were received traditional instructions by using the only lecture methods and gathered information using observations and informal assessments' at the side of teaching. Finally, the researcher was given post-test to assess students' conceptual understanding.

Table : Summary of the 5E Instructional Model

Phase	Summary
Engagement	The teacher or a curriculum task accesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote interest and provoke prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities.
Exploration	Exploration experiences provide students with a common base of activities within which current concepts (i.e., misconceptions), processes, and skills are identified and conceptual change is facilitated. Learners may complete lab activities that help them use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation.
Explanation	The explanation phase focuses students' attention on a particular aspect of their and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviors. This phase also provides opportunities for teachers to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the teacher or the curriculum may guide them toward a deeper understanding, which is a critical part of this phase.
Elaboration	Teachers challenge and extend students'

	conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills. Students apply their understanding of the concept by conducting additional activities.
Evaluation	The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward achieving the educational objectives.

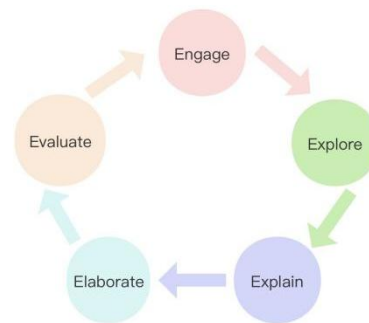


Figure 2 Summary of the 5E Instructional Model

2.5 Instrument of the Study

The data gathered tool to achieve the objectives of the study was pre-test, post-test, and classroom observation. This tool was used to get adequate information from the sample of the study. All instruments were described as follows:

2.5.1 Conceptual understanding measurement instrument

These instruments were in the form of a test, which is pre-test, post-tests and classroom observation. Test includes 15 multiple choice items and its duration of time was one hour and classroom observation was informally assessed students' progress.

Pre-test: The tools were an important tool to assess the students' prior knowledge and levels of understanding before the intervention started. This test helped to establish the homogeneity of the experimental and control group and also exhaustively covered the topic 'human anatomy'.

Post-test: The post-test was similar to the pre-test except for orders of the question. After the treatment, the researcher was given the post-test. This tool also important to know the progress of the students and measure conceptual understanding capacity through the lesson of human anatomy and the results were compared. The comparison was done between the experimental group and the control group's post-test scores. It was done in order to determine the groups which achieved higher than the other.

2.5.2 Classroom observation

Observation involves the systematic viewing of people's actions and the recording, analysis, and interpretation of their behavior. For this reason, the researcher was observed students during the intervention by checklists and informal assessments which used to evaluate a student's own performance, progress of knowledge and an investigating tool to find what prior knowledge of students, what their misconceptions, confusions

what they had and filled the gap within timely feedback. Finally, the results of each observation were interpreted.

2.6 Data collection procedure

The data were gathered through pre-test, post-test, and classroom observations keeping its procedure. Before beginning the actual data collection process the research outlined timetable about the whole work to make easy and effective the research process. First, the researcher was starting to administer the pre-test to learners in order to determine homogeneity in their knowledge of the topic, 'Human Anatomy'. The treatments were conducted after the administration of the pre-test for three weeks. The experimental groups were thought by using the model-based teaching approach during this time the lesson plan was applied by using 5E instructional design model while the control groups were thought by using traditional teaching approach the only lecture method and were taken informal assessments and observations at the side of teaching. Finally, the researcher was providing post-test to measure students' conceptual understanding.

3. Data analysis

In this study, based on the nature of the research question the data collected from the respondents were analyzed by using both qualitatively and quantitatively analysis techniques were employed. The data gathered through pre-test and post-tests were analyzed using mean, standard deviation and independent sample t-test analysis. The SPSS (20 version) application software was employed to analyze quantitative data. In addition to these observations and informal assessments were also analyzed qualitatively.

3.1 Descriptive statically analysis of pre-test and post-test results and interpretation for both Groups

Table 3: Pre-test results for descriptive analysis

Pre-test results	N	Mean	Std. deviation	Variance
Control	66	3.84	1.57	2.469
Experimental	66	3.81	1.60	2.582

Table 3, shows that the mean scores and variances comparison of the experimental and control group. This indicates that there is no statistical difference in the mean scores and variances of the experimental group (M=3.81, SD=1.60, Var=2.582) and control group (M=3.84, SD=1.57, Var=2.469) and the mean difference in the pre-test between the experimental and control group is 0.03. This means that the experimental and control groups have a very small difference in

Post-test scores	N	Mean	Std. deviation	Variance
Control	66	7.98	1.95	2.9
Experimental	66	10.14	1.62	2.582

mean score and variances, indicated that the two groups started at the same level.

Table 4: Post-test Results for descriptive analysis

Table 4, indicates the mean result experimental (M=10.14, SD=1.62 and Var=3.52) group and Control (M=7.79, SD=1.95 and Var=2.9) group for post-test. This indicates that there is a statistically significant difference in the mean scores and

variances of the experimental group differs significantly their mean difference is 2.35. This implies that there was a statistically significant difference in conceptual understanding between the students who instructed with model-based instruction and those instructed with traditional lecture method. This difference is statistically insignificant showing that the results could not happen by chance.

3.2 Inferential statically analysis of pre-test and post-test for both groups

Table 5: Independent sample t-test for Pre-test

Groups	T-test for Equality of Means					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Experimental & Control	-110	130	.913	.03030	-57759	.51699

When looks at Levene's test in table 3, (Page, 21), sig significant (sig>0.05), the samples were equal variances assumed. Table 5, shows that the independent sample t-test there was not a significant difference between the mean scores of the experimental group and the control group for the pre-test, before administration of the intervention to the experimental group. There was no significant difference in the pre-test scores at alpha level $\alpha = 0.05$, Sig (2-tailed) > 0.05, df (130), $t = 0.110$ indicating that the difference in the mean score was not significant. This result illustrated that both the students in the control and experimental group were similar in abilities before the treatment was administered. Hence, the two groups are equivalent. This conclusion is supported by Field (2009), when the P-value is greater than the level of significance, set by the researcher, the null hypothesis is not rejected and the conclusion is that the two means did not differ significantly.

Table 6: Independent Sample t-test for post-test

Groups	T-test for Equality of Means					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Experimental & Control	-7.516	125.505	.000	-2.34848	-2.96683	1.73014

When looks at Levene's test in table 3, sig significant (sig<0.05), the samples were equal variances not assumed. Table 6, shows the t-test comparison of the post-test score (p=0.05) to the alpha level ($\alpha = 0.05$). This conclusion is supported by Field, (2009), when the P-value is less than the level of significance, set by the researcher, the null hypothesis is rejected. This indicates that there are statistically significant differences in the mean scores of the experimental group differ significantly. Critical t-value ($t_{crit} = 2.35$) in the appendix, two-tailed and level of significance ($\alpha = 0.05$), ($T_{cal} (7.52) > T_{cri}(2.35)$, df 125.5, $P(0.001) < 0.05$). This shows that the result not existed by chance; therefore, there is a significant difference between the experimental and control group result in model-based instruction Varese lecture method.

Table 7: Effect of Gender Difference in Pre-test and Post-test

Gender	Group Statistic							
	Pre-test				Post-test			
	M	SD	T	Sig.(2-tailed)	M	SD	T	Sig.(p)
Female	3.	1.60	.33	.72	9.1	2.2	.6	.509
Male	3.	1.57	.33	.72	8.9	2.1	.6	.509

Based on an independent t-test results in the on table 5,(See page23), there was no significant difference in the score for male (M= 3.7, SD=1.57) and female (M= 3.9, SD=1.6) $t(130) = .33$, $p = 0.72$) for pre-test while in the post-test results for male (M=8.9, SD=2.1) and for female (M=9.1, SD=2.2), $t(130) = 0.66$, $P=0.509$). Since in both cases, the P-value obtained was greater than alpha level ($p>0.05$), which was no significant differences in students conceptual understanding; these results suggest that gender difference does not have an effect on students conceptual understanding.

4. Discussions of the results

Based on the finding of this study, the researcher demonstrated the following discussion concerning the role of model-based teaching approach how practically they implemented to improve students' conceptual understanding in human anatomy topics. All finding of this study was stated based on the data of pre-test, post-test, informal assessment and observation.

Hence, the research questions of this thesis are:

1.Is there a significant difference between context-based teaching approach and lecture method teaching approach when they thought human anatomy?

2.What is the effect of context-based biology instruction on students' conceptual understanding of human anatomy?

3.What is the interaction of students when they taught by context-based teaching approach?

With regard to the first research question to compare model-based teaching approach and traditional teaching approach on students' conceptual understanding about human anatomy the data on the pre-test, post-test, and observation revealed. In this study, before an independent sample t-test was carried out to check the normality and homogeneity of variance test of the data using levene's test and histogram test. The results could lead to the researcher to the conclusion that both groups were homogenous and have equal variance terms conceptual understanding before giving the treatment to the experimental group, after checking the normality and the Variance, independent sample t-test was carried out. There were no significant differences mean scores between the experimental groups (M=3.81, SD=1.60, Var.=2.58) and control group (M=3.84, SD=1.57, Var.=2.469) on pre-test scores (see table 3), both groups were similar level before the intervention was administered.

In addition, independent samples t-test was performed to check the differences in the pre-test score at alpha level ($\alpha=0.05$, $p>0.05$, $df=130$, $t=0.110$). Supported by Field,(2009), when the P-value is greater than the level of significance, set by the researcher, the null hypothesis is not rejected. This indicates that there were no statistically significant differences in the mean scores of both groups of the pre-test scores.

The main purpose of the study was to improve students' conceptual understanding of human anatomy topics for grade seven Ewket fana primary school students by using model-based teaching approach. The data collected by tests, classroom observation, and

When see the post-test scores of the experimental and control group are statistically significant difference these confirm the existence of evidence to prove change in the mean score experimental groups (M=10.14, SD=1.62, Var. =2.582) while the control groups of mean score (M=7.9, SD=1.95, Var.=2.9) (see table 4) and mean difference was 2.24 due to implementation of model-based teaching of experimental groups. To check differences by another way the independent samples t-test was supported by Field,(2009), when the P-value is less than the level of significance, set by the researcher, the null hypothesis is rejected. The t-test results indicated that the Experimental group scores were, statistically significantly Critical t-value ($t_{crit}= 2.35$ in the appendix), two-tailed (at $\alpha=0.05$, $P<0.05$ DF (130), $T= 7.52$).

The results of the analysis revealed that the experimental groups of students' performance were better than that of the control group and a significant difference between the mean scores of the two groups was observed. This was due to the use of the model-based instructional approach in the experimental group. According to Jackson, et al., (2008), modeling instruction program emphasizes active learning student construction of conceptual knowledge. Similarly, studies conducted by (Min et al., 2014), using a teaching model in the biology classroom his finding showed that students develop a better understanding of abstract concepts.

The significant difference between model-based teaching approach and traditional teaching approach when they thought human anatomy is shown above and it also determined the effect of a model- based teaching. The model-based instructional approach improves their understanding significantly for students in experimental groups, higher than those in the traditional instructional groups of teaching approach about human anatomy.

Through observational assessment learning by using model-based teaching approach the well-known misconceptions of many students was changed. The students' participation has increased on those experimental groups during the model-based teaching; students clear their misconceptions, were pay attention to the lesson, gradually increase their participation, interests. According to Mclachlan, (2003), the study that shows the importance of teaching by using models have great value in teaching biology, it directs students to explore biological objects and phenomena that inflexible to perceive directly and easy to understand the science concepts. The results of this study revealed that during preparation for model-based teaching human anatomy in particular misconceptions well known from literature should be included. On this result indicated that students perform better by discussing those wrong answers and with the help of the teacher they grab successfully the scientific model. One of the researchers' roles as a teacher in the classroom to help students, bridge the gap between their prior knowledge and new concepts in order to improve conceptual understanding. One way to do this is informatively assessed students along the way. It is imperative to understand where students' knowledge begins when starting a new unit of study so that teachers can be better, understanding their misconceptions. It is also equally important to continually monitor students' progress and re-teach concepts to build their conceptual knowledge.

5. Summary

informal assessments'. Based on the analyses made on the data, summary of the findings are forwarded as follows:

The mean for the experimental and control group pre-test scores was statistically is not significant. This implied that the control and

experimental group started at the same level. No group was superior to the other.

The mean for the experimental and control group post-test scores was statistically significant. The fact that the control and experimental group started at the same level, then the difference that was observed between the post-test scores of the two groups was due to the treatment. The experimental group outperformed the control group. The use of model-based teaching was, therefore, more successful than the traditional lecture method.

The informal assessments observational findings showed that students clear their misconception and increase their interests towards the topic.

The research using visuals models as a teaching method stimulates thinking and improves the learning environment in a biology classroom.

6. Conclusion

In this study, an intervention was applied in two groups carried out for three consecutive weeks. After the intervention, analysis of the results revealed that the experimental group outperformed the control groups in a special conceptual understanding of measurement tests. Due to the significant and meaningful results in the experimental group, superiority of model-based teaching is confirmed. On the other hand, model-based learning instruction has an effect on improving students' conceptual understanding, participation and interests. The students engaged in experimental groups gradually increase their participation; clear their misconceptions, and paying attention to the lesson during the model-based teaching. In general, as revealed under the results of independent t-test, learning by using model-based teaching approach is better than the lecture method approach. According to

Min, et al., (2014) , models are visual representations that a powerful tool because they help to make complex biological phenomenal to simple. Model-based teaching is intuitively a powerful tool for conceptual change and inherent to the process of science.

Finally, the result determined that students' understanding of biology class human anatomy topics can be improved and they became more interested in biology. Thus, from the results of this study, it is possible to conclude that the model-based teaching approach is a more effective method to contribute students' conceptual understanding when they learn to human anatomy in biology.

7. Recommendations

The study's results can also lead to a number of possible recommendations to different concerned bodies regarded by their responsibilities.

The model-based instructional has a positive effect on students' conceptual understanding hence teachers should be encouraged to employ it more in the teaching biology.

Teachers may be given importance to the students' opinion regarding the models understanding.

Teachers should try as much as possible to use these models in the teaching of difficult concepts in biology.

School principals encourage biology teachers to use models by preparing enough instructional materials like model of skeletal system.

In addition to their school principals also add additional classroom in order to minimize large class size.

Studies should consider these views in designing the curricula, textbooks, teaching activities and materials and teacher educational processes.

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