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# Effects of Guided Inquiry and Cartoon Animation On Academic Performance of Secondary School Students in Biology in Ekiti State

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## Abstract

This study investigated the effect of guided inquiry and cartoon animation on the academic performance of students in Biology in secondary schools in Ekiti State. The study was a quasi – experimental research which adopted the pre-test post-test research design. The population for the study comprised 9,763 Senior Secondary School class two students in Ekiti State out of which 120 students were selected using multistage random sampling technique. The instrument used for the study was the Biology Achievement Test (BAT) designed by the researcher. The face and content validity of the instrument were ensured by the experts in the Department of Science Education and Test and Measurement. The reliability of the instrument was determined through a test retest method using Pearson's Product Moment Correlation analysis which yielded reliability co-efficient of 0.76. The data obtained through the instrument were analyzed using descriptive and inferential statistics of mean, standard deviation, Analysis of Variance (ANOVA), and Analysis of Covariance (ANCOVA) all tested at 0.05 level of significance. The finding of the study revealed that there were significant difference between the mean pre-test and post-test scores of students taught Biology using guided inquiry, lecture method and cartoon animation. Highest scores were recorded when cartoon animation method was used in instructional delivery followed by guided inquiry method while lecture method has the least mean score in the post – test. Based on the findings of the study, it was recommended, among others, that Biology teachers should deliver their lessons to students using cartoon animation and guided inquiry method of teaching. It was also recommended that the Ministries of Education and curriculum planners should adopt the appropriate cartoon animation method with guided inquiry for use by teachers to teach topics highlighted in the Biology curriculum.

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## Introduction

Science is an essential tool for global progress, development, and improvement. Education in Science and Technology is the essential foundation for attaining enduring national advancement, protecting human societies from ignorance, illiteracy, disease, and poverty (Onyegbegbu, 2006). The instruction of scientific concepts starts in nursery schools and persists through primary, secondary, and tertiary educational institutions. Biology underpins fields including Medicine, Biochemistry, Microbiology, Zoology, Botany, and Environmental Sciences, among others.

The objective of studying biology is to provide learners with knowledge regarding the natural world and its living species. Students gain information, comprehension, concepts, and techniques in Biology, while cultivating essential skills and attitudes. The objectives of Biology education at the secondary school level, as delineated in the National Policy of Education (NPE, 2004), include the enhancement of laboratory and field skills, the attainment of relevant and applicable knowledge, the capacity to apply scientific knowledge to daily life concerning personal and community health and agriculture, and the fostering of rational and pragmatic scientific attitudes.

The concepts, empirical principles, and theories formed from the comprehension of Biology underpin human material welfare. As we approach the 21st century, with optimistic expectations for enhanced global health, sufficient food resources, improved comprehension of human, animal, and plant biology, and diminished pollution from sulphur dioxide and radioactive substances, it is essential to teach and learn Biology effectively to address the forthcoming challenges facing humanity.Biology is a core subject taught at the senior secondary school level, not with the anticipation that students will pursue careers as biologists, but to furnish them with a foundational comprehension of biology as a scientific study. Nonetheless, there has been a persistent decline in the academic performance of students in the Senior School Certificate Examination (SSCE), especially in the subject of Biology. The performance of students in the Ekiti State Senior Secondary Certificate Examination, conducted by the West African Examinations Council, was disappointing. In 2011, fifty percent of the students failed to pass. In 2012, 76.9% of the applicants failed to pass. In 2013, 51.7% of applicants failed the Biology examination (Ekiti State Ministry of Education and Technology, 2014). This troubling trend should alarm Science teachers in Nigeria.A multitude of hypotheses has been proposed for this drop. The causes contributing to the issue encompass deficient pedagogical methods, a scarcity of qualified instructors, poor infrastructure and educational resources, weak communication skills, and a restricted comprehension of certain biological concepts (Adesoji, 2008). The approach employed in an educational environment is vital, as the way a teacher conveys the subject matter to students can greatly affect their interest or distaste for the material.

The instructional method directly affects students' responses and interactions with a lesson, shaping their interest, motivation, and engagement levels. This therefore affects the efficacy of their learning experience. The application of appropriate pedagogical methods characterises an effective teaching and learning experience for

all students in every discipline. Ogunniyi (2009) contended that a substantial and persistent problem impacting academic performance in Nigerian educational institutions is the insufficient quality of teaching methods.teachers endeavour to maximise their effectiveness in the classroom as a principal professional goal. Numerous research investigating teachers' efficiency (Abdulahi, 2009; Amos, 2002; King, 2001) unanimously concurred that a clear presentation of the subject matter is an essential requirement. Expertise in a specific domain does not automatically qualify an individual as an effective teacher. Biology teachers should have expertise in several pedagogical approaches and apply them judiciously as required.

Multiple innovative pedagogical approaches, including as guided discovery, cooperative learning, activity-based learning, guided inquiry, concept mapping, and cartoon animation, have been suggested to improve the efficacy of teaching science courses. Notwithstanding the presence of these research findings, confusion persists over their practical use in the field. Numerous pedagogical methods have been employed in the teaching of Biology for over twenty years.

Mtsem (2011) characterises the lecture technique as an oral presentation conducted by the lecturer for Biology students. teachers appreciate this method for its capacity to regulate both the content and time. The lecture method is an educational style defined by a one-way transmission of information, wherein the teacher presents the subject matter orally while students listen attentively and take notes. This method involves the instructor providing all essential knowledge and skills to the students, with less emphasis on their active participation and contribution to the lesson's efficacy. This method is especially appropriate for large courses as it facilitates the effective dissemination of substantial content within a constrained period. The lecture method of instruction frequently involves the narration of stories. This method relegates learners to the status of mere transcribers and passive receivers of knowledge. The pace at which students understand and grasp the subject matter is frequently slow.

Guided Inquiry entails meticulous preparation, vigilant oversight, continuous evaluation, and focused intervention by a collaborative team of teachers throughout the inquiry process, ultimately fostering students' progression towards autonomous learning. The guided inquiry method is an instructional style designed to assist students in formulating enquiries and uncovering answers to those enquiries. Inquiry techniques enable the observation of events, the identification of pertinent and extraneous questions, the exploration of facts, and the assumption of full responsibility for the comprehensive process of acquiring, organising, and interpreting data (Amos, 2002). The primary objective is to cultivate autonomous learners capable of enhancing their knowledge and competence via proficient utilisation of diverse information sources, both within and beyond the educational institution. Guided inquiry necessitates that students independently discover information. This is unfeasible in a lecture-oriented teaching technique with passive study habits. The implementation of the guided inquiry approach for teaching Biology, along with an active study regimen, will enhance student motivation and engagement in the session. It directs students' attention and stimulates problem-solving.

Students should be afforded the chance to explore, innovate, and engage in the swift advancement of science and technology. Biology is a scientific discipline that significantly influences national development, necessitating the introduction of novel pedagogical approaches, such as the guided-inquiry technique, for secondary school biology students. Exposure to the guided inquiry approach of teaching in secondary schools will enable Biology students to apply information, communicate effectively, and develop analytical, critical thinking, inquisitive, and imaginative skills. A student must possess self-confidence, motivation, creativity, and curiosity (NBTE, 2006). Upon acquiring the requisite skills and mindset through effective pedagogical approaches, a human may endure even in arid environments.

Cartoon animation teaching is a medium that incorporates both auditory and visual elements utilised in the educational process for effective knowledge dissemination; it entails the delivery of programs or instructions recorded on video tape or disc by media specialists or experts. It engages both the visual and auditory senses of the learner, hence enhancing memory retention and recall abilities. Cartoon animation captivates learners with vibrant, vivid, and compelling imagery.

The incorporation of animated materials, such as cartoons, in education diminishes learning time and expenses, fosters instructional consistency, enhances subject mastery, improves retention, bolsters safety, elevates motivation, and expands accessibility, as student instruction is not limited to the instructor's availability. Students appreciate interactive learning due to its efficiency, effectiveness, and flexibility; it enhances communication, engages both visual and auditory senses simultaneously, offers a tangible foundation for comprehending abstract and complex concepts, and fosters more significant and enduring learning (Kellerman, 2004).

The notion that males excel over girls in Biology is evidently a fallacy. A recent meta-analysis indicates that there is no gender disparity in the comprehension of biological ideas (Kuncel, 2011). Male and female individuals differ in their anatomical structure, characteristics, and hereditary attributes. Hereditary attributes are physical features that organisms acquire from their progenitors. Boys possess a more pronounced awareness of the concept of masculinity compared to girls. The majority of girls exhibit a lack of enthusiasm and participate less in science and related subjects (Ogunboyede, 2000).

Popoola (2008) identified potential gender disparities in intellectual development and performance in her research. She determined that guys excelled in science. Boys exhibit specific traits while confronting particular situations that may appear rational or abstract. Ibe (2012) conducted a study comparing the performance of students in Biology and discovered no significant difference between male and female students' performance.

The purpose of this study was to investigate the effect of guided inquiry and cartoon animation methods on the academic performance of students in Biology in secondary schools. The study examined which of the three methods would best improve students' performance in Biology.

**Research Questions**

The following research questions were raised to guide the study:

1. What are the performance of students in Biology exposed to lecture, guided inquiry and cartoon animation method?
2. Which of the three methods of lecture, guided inquiry and cartoon animation would be most effective in teaching of Biology?

**Research Hypotheses**

The following null hypotheses were generated for this study.

1 There is no significant difference in the pre-test and post-test mean scores of students taught Biology using the three methods of teaching.

2 There is no significant difference in the post-test mean scores of students taught Biology using lecture, guided inquiry and cartoon animation teaching methods.

**Research Methods**

This study adopted quasi – experimental pre-test and post-test three group design (three experimental groups). The base line of the knowledge of students that were used for the study was established by pre-test while post-test was used to measure learning outcomes after the treatment. The pattern of the design is as shown below.

$O_1$ $X_1$ $O_2$: Experimental group I

$O_3$ $X_2$ $O_4$: Experimental group II

$O_5$ - $O_6$: Control group

Where

$O_1$, $O_3$, $O_5$, – Pre-test scores (Performance before treatment)

$O_2$, $O_4$, $O_6$, – Post-test scores (Performance after treatment)

$X_1$ – Treatment via Cartoon Animation

$X_2$ – Treatment via Guided Inquiry

The targeted population for the study were all the 9,763 Senior Secondary School (S.S.S.) class two students in public secondary schools in Ekiti state. The choice of S.S.S. 2 students was considered more appropriate because they had been exposed to some basic Biology concepts in their previous year. The sample consisted of 120 students drawn from three public secondary schools in Ekiti State. The sample was selected using multistage sampling technique. One Senatorial district was randomly selected from the three senatorial districts in Ekiti State. Three Local Governments were randomly selected from the senatorial district earlier selected. One public secondary school was randomly selected from each of the three local governments chosen for the study. Stratified sampling technique was used to select 40 students from each school bearing in mind their sex (i.e. 20 male students, 20 female students). Random Sampling technique was used to group the schools into different experimental groups and a teacher was purposely selected from each school to handle the experimental group his/her school fell under.

The tool employed for the research was designated as the "Biology Achievement Test (BAT)." A Cartoon Animation Disc created by the researcher was utilised to enhance the BAT. The Biology Achievement Test (BAT), created by the researcher, comprised parts A and B. Section A comprised the respondents' bio-data, including the school

name, identification number, and gender. Section B had 30 objective items with four alternatives, including seven questions on Knowledge, seven on Comprehension, six on Application, six on Analysis, two on Synthesis, and two on Evaluation. The items were selected from all themes (Cell, Reproduction, and Respiration) addressed in the research. The items were utilised for both the pre-test and post-test phases of the investigation. The materials of the BAT utilised for the pre-test were rearranged for the post-test to mitigate the carry-over effect. The Cartoon Animation Disc encompassed all the biological themes pertinent to this research, specifically Cell, Reproduction, and Respiration. The Cartoon Animation Disc was designed to provide educational content to students in a visual cartoon format.

The Biology Achievement Test (BAT) was administered to two specialists in Test and Measurement from the Department of Guidance and Counselling and two seasoned Senior Secondary School Biology teachers. The experts and the researcher's supervisor evaluated the face and content validity to analyse the phrasing, ambiguity, and comprehensiveness of the test items. Fifty things initially submitted to the experts were diminished to thirty after their ideas and recommendations. A test-retest technique was employed to ascertain the instrument's dependability. The assessment was conducted twice on 30 kids in a school in the Ado Local Government region, which was outside the designated study region, with a two-week interval between tests. The scores from the two tests were associated using Pearson's Product Moment Correlation analysis, resulting in a reliability coefficient of 0.76. This value was sufficiently elevated to render the instrument suitable for utilisation. Consequently, the tool was deemed trustworthy and appropriate for the investigation.

To carry out the research in the schools, the researcher obtained permission from the authorities of the three schools. Therefore, a day workshop was organized for each of the research assistants on the respective methods used in teaching their students from the selected schools.

The study was carried out in three phases:

Phase I: Pre-treatment Stage

The researcher administered pre-test instrument, the instrument was administered to all groups in order to ascertain the homogeneity of the three groups. The instrument used was Biology Achievement Test (BAT).

Phase II: Treatment Stage

a) Experimental group one (Cartoon Animation): The training package consisted of cartoon animation disc. Students were exposed to forty minutes of teaching and discussion twice per week for six consecutive weeks. The Cartoon Animation Disc was played on a Computer system and projected on a screen with the aid of a projector in the classroom. The computer system screen was considered to be too small, that was why it was projected on a larger screen. It was designed to assist students to acquire specific skills and direct their efforts towards better comprehension and sustenance of improvements. Students will be involved in twelve sessions consecutively, covering all the topics (Cell, Reproduction and Respiration) using the cartoon animation disc.

b) Experimental Group 2 (Guided Inquiry): Students were exposed to forty minutes of teaching and discussion twice per week for six consecutive weeks. The three topics (Cell, Reproduction, and Respiration) were explained by the teacher and the teacher allowed each of the students to work independently but under the guidance of the teacher.
c) Experimental Group 3 (Lecture): Experimental group 3 has no special treatment. They were taught via normal classroom interaction for six weeks covering the three topics (Cell, Reproduction, and Respiration)

Phase III: Post-treatment Stage

At the end of the treatment stage, BAT was re-administered on the students to determine the effects of the treatment on them. The same Biology Achievement Test (BAT) used during the pre-test was re-arranged to avoid test-wiseness and administered to the experimental groups

The data generated from the instrument were analyzed using descriptive and inferential statistics. The general questions were answered using means and standard deviation. Hypothesis 1 was tested using Analysis of Covariance (ANCOVA), hypothesis 2 was tested using Analysis of Variance (ANOVA). All the hypotheses were tested at 0.05 level of significance.

**Results**

**Question 1:** What are the performance of students in Biology exposed to lecture, guided inquiry and cartoon animation method?

The post test scores of students in the three groups were used to answer this question.

**Table 1:** Mean and standard deviation of post-test scores of students exposed to lecture, guided inquiry and cartoon animation method

| **Groups** | **N** | **Mean( $\bar{X}$)** | **S.D** |
|---|---|---|---|
| Lecture | 40 | 15.25 | 2.48 |
| Guided inquiry | 40 | 17.68 | 2.84 |
| Cartoon animation | 40 | 19.10 | 2.27 |
| **Total** | **120** | | |

Table 1 shows the mean post-test scores of students' performance in Biology. The mean post-test score for lecture method group is 15.25, guided inquiry group is 17.68 and cartoon animation group is 19.10. Thus, cartoon animation group which has the highest mean of 19.10 appears to be the best method out of the three methods in the teaching of Biology.

**Question 2**: Which of these three methods would be the most effective in the teaching of Biology?

The scores of the students before being taught with the different methods (pre-treatment and post treatment scores) were used to answer this question.

**Table 2:** Mean difference scores and standard deviation of Student's Performance in Biology

| **Variations** | **N** | **Mean ( $\bar{X}$)** | **Mean** | **SD** |
|---|---|---|---|---|

| | | Pre test | Post test | difference | |
|---|---|---|---|---|---|
| Lecture | 40 | 10.38 | 15.25 | 4.87 | 2.478 |
| Guided inquiry | 40 | 10.90 | 17.68 | 6.78 | 2.842 |
| Cartoon animation | 40 | 10.56 | 19.10 | 8.54 | 2.269 |

Table 2 shows that the mean difference scores of students' performance in Biology. The mean difference for lecture group is 4.87, guided inquiry group is 6.78 and cartoon animation group is 8.54. Thus, the Cartoon animation teaching method which has the highest mean difference of 8.54 is the most effective out of the three methods in the teaching of Biology.

**Testing Hypotheses**

**Hypothesis 1:** There is no significant difference in the pre-test and post-test mean scores of students exposed to Lecture, guided inquiry and cartoon animation teaching methods.

**Table 3:** Analysis of Covariance (ANCOVA) for pre – test and post –test mean scores of students' performance under the groups

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 3435.340[a] | 5 | 687.068 | 25.645 | .000 | .626 |
| Covariate | 3184.208 | 1 | 3184.208 | 118.849 | .000 | .608 |
| Pre-test | 106.519 | 2 | 53.260 | 1.988 | .218 | .130 |
| Post-test | 1357.695 | 1 | 1357.695 | 50.675 | .000 | .398 |
| Pre-test * Post-test | 501.137 | 2 | 250.569 | 9.715 | .000 | .047 |
| Error | 3054.304 | 114 | 26.792 | | | |
| Total | 159298.000 | 120 | | | | |
| Corrected Total | 5489.644 | 119 | | | | |

a. R Squared = .626 (Adjusted R Squared = .615)

In table 3, it was revealed that there is a significant difference between the pre – test and post – test score of students under the groups as F – cal (2, 114) = 9.715, P < 0.05 level of significance. Also there was a significant difference in the post test mean score of students under the group as F – cal (2, 114) = 50.675, P< 0.05 level of significance. It was further revealed that there was no significant difference in the pre – test mean score of students under the groups as F-cal (2,114) = 1.988, P> 0.05. These values led to the rejection of null hypothesis 1. Hence, there is significant difference in the pre-test and post-test mean scores of students exposed to Lecture, guided inquiry and cartoon animation teaching methods.

In order to investigate the direction of differences observed in the post test score of the three groups, Scheffe post – hoc test was carried out and the result is presented in table 4 below.

**Table 4:** Scheffe Post – hoc test for observed difference in the effect on students' performance in the groups

| Groups | Mean | Lecture | Guided Inquiry | Cartoon Animation |
|---|---|---|---|---|
| | | 15.25 | 17.68 | 19.10 |
| **Lecture** | 15.25 | | | |
| **Guided Inquiry** | 17.68 | 2.4289* | | |
| **Cartoon Animation** | 19.10 | 3.8506* | 1.4179 | |

* P < 0.05

In table 4, a significant difference was found between lecture and guided inquiry in favour of guided inquiry. Also there was significant difference between lecture and cartoon animation method in favour of cartoon animation. However, there was no significant difference between guided inquiry and cartoon animation. The result of post – hoc test also showed that students exposed to cartoon animation performed best. They performed significantly better than their counterparts in other two groups. Moreso, those exposed to guided inquiry performed better than those in lecture method. These further justified the differences observed.

**Hypothesis 2:** There is no significant difference in the post-test mean scores of students in Biology using lecture, guided inquiry and cartoon animation teaching methods.

**Table 5:** ANOVA of students post-test mean scores in Biology using the three methods

| Variations | SS | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 303.117 | 2 | 151.556 | | |
| Within Groups | 1315.875 | 117 | 11.247 | 13.476 | .000 |
| **Total** | **1618.992** | **119** | | | |

P < 0.05

From Table 5, the p-value (0.000) is less than 0.05 level of significant i.e. P (0.000) <0.05. The null hypothesis is rejected, showing that there is a significant difference in the post-test mean scores of students taught with lecture, guided inquiry and cartoon animation methods of teaching.

Turkey analysis was used to show the difference among the groups.

**Table 6:** Turkey Multiple Comparisms of student' post-test scores

| (I)group | (J) group | Mean Difference I-J | Std Error | Sig. | 95% confidence internal for difference | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| LG | GIG | -2.425* | 0.7499 | .004 | -4.2052 | -0.6448 |
| | CAG | -3.850* | 0.7499 | .000 | -5.6302 | -2.0698 |
| GIG | LG | 2.425* | 0.7499 | .004 | 0.6448 | 4.2052 |
| | CAG | -1.425 | 0.7499 | .143 | -3.2052 | 0.3552 |
| CAG | LG | 3.850* | 0.7499 | .000 | 2.0698 | 5.6302 |
| | GIG | 1.425 | 0.7499 | .143 | -0.3552 | 3.2052 |

* P < 0.05 (*Key: LG- Lecture Group; GIG- Guided Inquiry Group; CAG- Cartoon animation Group*)

Table 6 revealed that there is a significant difference between lecture method and guided inquiry method (P(0.004)<0.05) and between lecture method and cartoon animation method (P(0.000) < 0.05). But there is no significant difference between guided inquiry method and cartoon animation method (P>0.143) >0.05

**Discussion**

The study's findings indicated that the cartoon animation teaching technique is the most effective approach for teaching Biology, in comparison to guided inquiry and lecture methods. This aligns with Aremu and Sangodoyin (2010), who assert that cartoon animation effectively enhances students' performance in Biology. This conclusion contradicts Wilson (2010), who determined that cartoon animation is an ineffective pedagogical approach for teaching Biology.

The study's findings indicated that the used teaching approaches significantly affect students' performance in Biology. This is clear from the variation in students' performance across the lecture technique, guided inquiry method, and cartoon animation approach. This aligns with Seweje (2010), asserting that effective teaching approaches had the capacity to enhance student cognition. This further substantiates the initial hypothesis of this study that guided inquiry or cartoon animation may enhance meaningful learning in Biology.

Moreover, the results indicated a substantial (very wide) disparity in the pre-test and post-test scores of students in Biology among the groups, particularly within the cartoon animation group. This outcome aligns with the assertion of Ango & Silas (2006) that employing cartoon animation groups augments students' understanding and facilitates the absorption of information. Consequently, students prefer to get superior performance with the cartoon animation approach. Semper (2002) concluded that scientific teachers may influence students' perspectives by involvement at critical moments in their learning, a process known as inquiry-based learning. Furthermore, Staylor (2002) and Kellerman (2004) asserted that animated instructional tools enhance communication by simultaneously engaging visual and auditory senses, thereby offering a tangible foundation for comprehending distracting and challenging scientific subjects. Osokoya (2007) supported the belief that audio-visual aids in the sciences effectively communicate scientific ideas and concepts to students. It is not surprising that students achieve superior results in guided instruction and cartoon animation instructional approaches.

The data indicated a substantial variation in the post-test scores of students across the three groups. A notable distinction appears between the lecture group and the guided inquiry group, as well as between the lecture group and the cartoon animation group; however, no significant difference is seen between the guided inquiry group and the cartoon animation group. This indicates a significant disparity between the lecture approach and both guided inquiry and cartoon animation methods in improving student performance in Biology; nevertheless, guided inquiry and cartoon animation methods do not differ in their effectiveness for raising performance in Biology. These

findings correspond with those of Ugwuadu (2014), who noted that the guided inquiry instructional approach was more successful than the lecture method in improving students' academic performance in Biology. The rationale for this may not be implausible; for instance, Akem (2007) noted that the lecture technique entails the instructor disseminating all pertinent information to the students, with minimal regard for the students' active engagement and contribution to the lesson's efficacy. Abah (2006) asserted that skills are best acquired by practice rather than passive listening, as is the case with the lecture technique.

This outcome corroborates the study findings indicating that the guided inquiry technique improved students' performance in scientific subjects, including Biology (Fatokun & Yolams, 2007; Akums, 2007; Okoli, 2006; Wilson, 2014). Aremu & Sangodoyin (2010) similarly observed that cartoon animation effectively enhanced students' success and thus suggested it as a pedagogical tool for teaching Biology in Nigerian secondary schools.

The discovery aligns with the "Remembering and Forgetting" learning theory, which posits that when instruction occurs across many sensory modalities, the learner is likely to retain the acquired knowledge for an extended period. Humans possess five sensory organs. The lecture and guided inquiry teaching technique just engaged the auditory sense organ in the educational process, but cartoon animation integrated both auditory and visual senses, hence enhancing the efficacy of Biology instruction and learning.

**Conclusion**

It can be concluded from the findings of this study that Lecture method has impact on the students' academic performance in Biology; Guided Inquiry is more effective while Cartoon Animation is most effective. The use of Cartoon Animation and Guided inquiry helped the students to achieve maximally in Biology during teaching.

**Recommendations**

Based on the findings of this study, the following recommendations were made:

- The use of the Guided Inquiry with Cartoon Animation approach should be promoted for teaching Biology in secondary schools.
- Biology educators should receive sufficient training via workshops and seminars to enhance their proficiency in employing Cartoon Animation and the Guided Inquiry technique in instruction.
- Biology textbooks ought to integrate the Guided Inquiry with Cartoon Animation pedagogical approach.
- Curriculum development should focus on Guided Inquiry utilising Cartoon Animation to instruct Biology.
- Time assigned to educators must be well managed to facilitate the implementation of Guided Inquiry using Cartoon Animation for teaching Biology.

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