

Score Level, Text Structures and Senior Secondary School Students' Achievement in Genetics in Ilorin, Nigeria

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Genetics is one of the hard to learn biological concepts owing to its connectedness to Latin / Greek origin. Hence, the need for its proper structuring for easy comprehension by the students. The effectiveness of text structure on students' proper understanding had been widely reported in literature, hence, this study investigated score levels, text structures and senior secondary school students' achievement in genetics. Specifically, the study assessed the: (i) variation in the achievement of students taught using different text structures (ii) interaction effects of text structures and score levels on senior school students' achievement in genetics among others. A quasi-experimental design of pretest, posttest, non-equivalent, and non-randomized control group was adopted. A total of 239 students purposively selected took part in the study. ANCOVA was used to analysed the hypotheses at 0.05 alpha level. Findings indicated that there was (i) a statistically significant difference in the achievement of students exposed to different text structure i.e., $F(2, 238) = 15.11$ at $p < 0.05$; (ii) no statistically significant difference in the interaction effects of text structure and score level. The implication of the finding is that the two structured texts were useful for improving senior school students' achievement in genetics. It was therefore, recommended that biology teachers should consider logical prose and concept maps in structuring their instructional materials.

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Keywords: Score level, text structure, achievement, genetics

INTRODUCTION

The significance of understanding the contents of instruction cannot be over emphasis, this is why researchers utilise the knowledge of text structure to either sequence the content meant to be taught or uses it as a teaching strategy. Text structure is the arrangement of the instructional contents presented to learners. Text structure involve exposing students to all the details they need to know as far as the contents of instruction are concerned. It was defined by Glass and Zygoris-Coe (2005) as identification of the important structural elements in a particular type of text. Friedman and Friedman (2013) described it as organisational pattern of information within a text. This implies that text structures reveal the detailed of instruction to learners for meaningful understanding of instructional contents.

Text structure is used across all fields to enhance students' learning. Several means of structuring text had been identified ranging from graphic, prose, concepts map to mention a few. Researchers across the world had utilized text structure either in structuring their topics as instructional or teaching strategies. The efficacy of structuring to teaching and learning processes had been affirmed by these researchers (Cheng, 2019; Gaddy *et al.*, 2008; Hall-Mills & Marante, 2021; Wu & Alrabah, 2020). The usefulness of text structure instructional strategy on postsecondary school students was compared to traditional instruction on reading comprehension. The result of the analysis revealed that those in the structured group performed better than those in the

traditional class (Gaddy *et al.*, 2008). Cheng (2019) explored the effects of teaching text structure in science text reading among Chinese students. The result revealed that students taught with structured text performed significantly better in the comprehending science texts than the control group. Wu and Alrabah (2020) examined the impact of text structure strategy on English Foreign Language college students. The college students approach to expository and medical texts were examined and it was found that learning of expository text had assisted students reading of medical text. Hall-Mills and Marant (2021) also confirmed the efficacy of text structures in increasing the knowledge and awareness of specific structure and structures signal. These findings are attestations to the usefulness of text structures to contents understanding.

In this context, the sequence of instructional contents as well as the order of presentation were considered. As such, the logical prose and concept maps form of structuring genetics concepts of Biology had been adopted. Logical prose clarifies the concepts or expressions as they build up, relates the instances to prior experiences of students and assist them in seeing the relationship of what is learnt to what happen around them. It is mainly descriptive and contains simplified terminology in exactitude. It is a method of structuring that takes into cognizance the order of presentation of the explanations, ideas or concepts. The logical prose in this study involves, finding other sentences or terms that mean the same as sentence built up to further explain the sentence for more clarification. Concept map on the other hand presented genetics instruction to learners from general to specific (deductively) in the form of graphics. It also considered the order of occurrence of these terms and the relationship existing among them. The effects of these text structures on students scoring levels were explored as well as the interaction effects of the text structure and score levels.

Score levels are often used interchangeably with ability level. It is important to state that score level will be preferred because only few concepts were put into consideration. Researchers have established variations in students score level, some of which are (Adeniran, 2011; Obochi, 2021). The finding of Adeniran (2011) indicated that all the score levels benefited from the study, and that low score level students performed the best when taught physics using problem solving strategy. The finding of Oboji (2021) corroborate the finding of Adeniran (2011) that problem solving strategy significantly influence the achievement and retention of low scoring students.

Purpose of the Study

The main purpose of this study was to determine the comparative effects of text structures on achievement in genetics of senior secondary school students in Ilorin, Nigeria. Specifically, the study determined the:

1. difference in the achievement of students in genetics taught using different forms of text structures;
2. difference in the achievement of high, medium and low-scoring students taught genetics using logical prose.
3. difference in the achievement of high, medium and low-scoring students taught genetics when concept map was used.



4. interaction effect of text structures and score levels on senior secondary school students' achievement in genetics.

Research Questions

Answers were provided to the following research questions

1. Do students achieve differently when taught genetics using the different text structures?
2. Are there differences in the score levels of students achieve taught genetics using logical prose?
3. Do students with different score levels achieve differently when taught genetics using concept map?
4. What are the interaction effects of text structures and score levels on senior secondary school students' achievement in genetics?

Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

HO₁: There is no statistically significant difference in the achievement of students taught genetics using different text structures.

HO₂: There is no statistically significant difference in the achievement of low, medium and high-scoring students when taught genetics using logical prose.

HO₃: There is no statistically significant difference in the achievement of low, medium and high-scoring students when taught genetics using concept map.

HO₄: There is no statistically significant difference in the interaction effects of text structures and score levels on senior secondary school students' achievement in genetics.

RESEARCH DESIGN and METHOD

Purposive sampling techniques was utilized to select 239 students that took part in the study; 122 of which were males and 117 were females. The participant age ranges from 15 to 17 years; they are mostly Yorubas, though minority of them were Igbos and Hausas. The schools that took part in the study were co-educational. Quasi experimental design of a pre-test, post-test non-equivalent, non-randomized intact classes was adopted. A 3X 3 factorial design was upheld: the first 3 indicating the three text structures i.e., logical prose, concept map and teachers' usual manner of structuring. The other 3 described the score levels, i.e., high, medium and low. The score level was determined using the terminal results of the students involved. Three instruments were developed, two of which were stimulus; Logical Structure of Concepts Involved in Genetics (LSCIG) and Concept map Structure of Genetics Contents (CSGC). The third was a response instrument, i.e., Achievement Test in Genetics ATG.

The 78 items of the ATG were subjected to item analysis was conducted on them, and their discriminating and difficulty indices determined. The genetics contents that were covered by the questions included: the introduction to genetics, characters that can be transmitted and Mendel's (1867) work on genetics. The ATG questions were adapted from the West African Senior Secondary School Certificate Examination (WASSCE) and National Examinations Council (NECO) past questions. Some of the items were modified by restructuring them. To ensure the validity of the ATG, the items of the ATG were restructured

for grammatical constructions and the presence of appropriate distracters in the options. The remaining 68 questions were restructured and used as the ATG, to measure the achievement of students in genetics. Pearson's Product Moment Correlation statistics was used to obtain a reliability value of 0.89.

RESULTS

The demographic characteristics of the groups is presented in Figure 1 while Figure 2 presents the frequencies of high, medium and low scorers in each of the groups

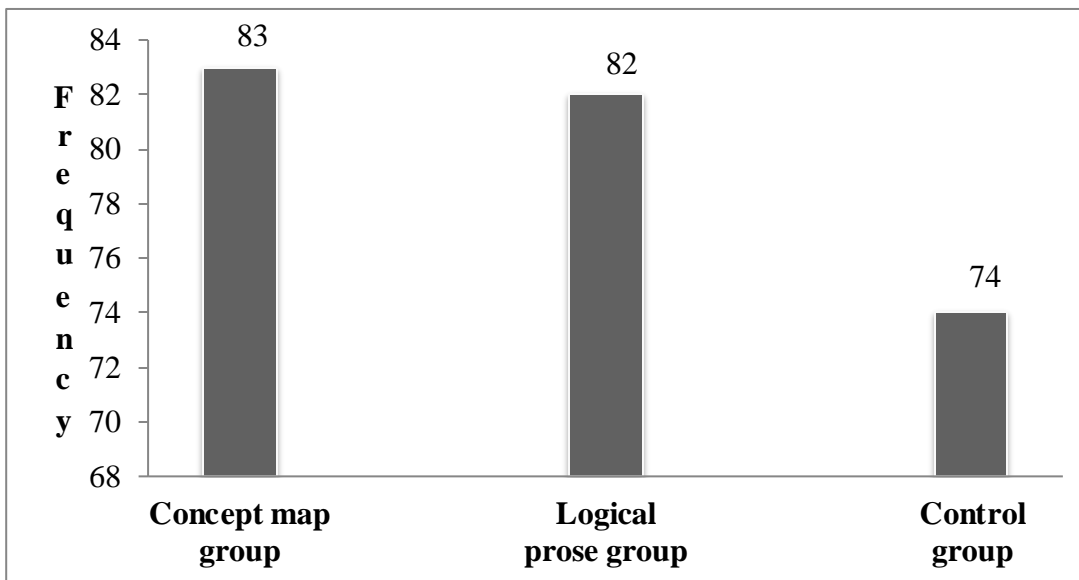


Figure 1: Demographic Representation of the Participants Based on Treatment Groups.

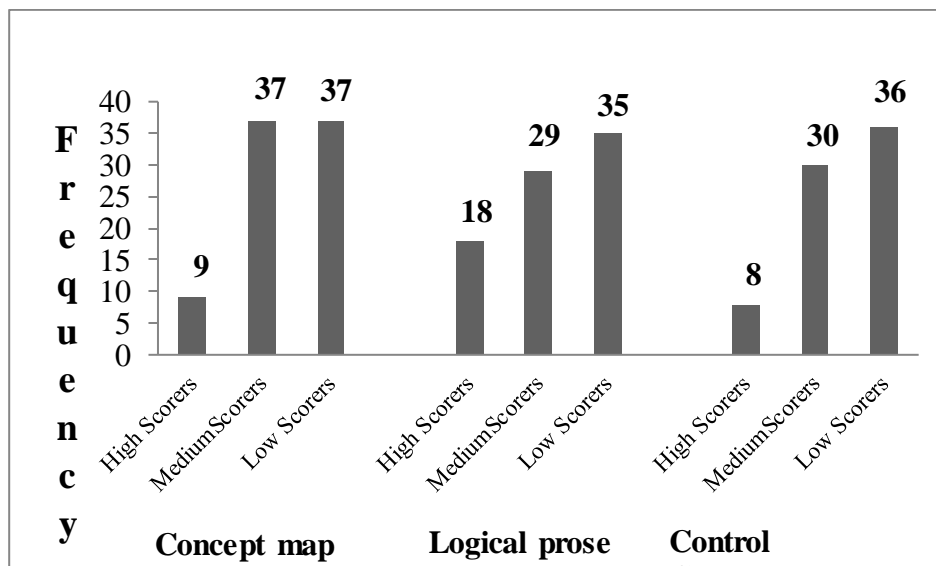


Figure 2: Demographic Representation of the Participants Based on Score Levels.

Research Question 1: Do students achieve differently when taught using different text structures?

The description of the differences in the achievement of students' in genetics when exposed to different text structures is presented in Table 1.

Table 1: Description of the Achievement of Students in Genetics when Exposed to Different Text Structures

Treatment	N	Pre-test (\bar{x})	SD	Post-test (\bar{x})	SD	(\bar{x}) Score	Gain
Logical prose	82	48.02	16.10	65.26	15.19		17.24
Concept map	83	47.84	14.37	64.13	15.29		16.29
Control	74	46.08	13.25	58.77	13.42		12.69

Table 1 reveals that students achieved differently when taught genetics using different text structures. The table shows the mean gain score of the logical prose, concept map and control to be (17.24), (16.29) and (12.69) in the given order. It could be inferred from the table that, logical prose group achieved best. Next was the concept map group, while the control had the least achievement indicated by the lowest mean gain score. This suggests that students had varying achievement when taught genetics using different text structures.

Hypothesis 1: There is no statistically significant difference in the achievement of students taught genetics using different text structures. To test for the statistically significant difference in the achievement of students exposed to different text structures, i.e., logical prose, concept map and the control, students' scores were subjected to Analysis of Covariance and the result is presented in Table 2.

Table 2: The Analysis of Covariance of Mean Score of Students Exposed to Different Text Structure

Source	Type III Sum of Square	df	Mean Square	F	Sig
Corrected Model	46231.77 ^a	3	15410.59	497.91	0.00
Intercept	7355.78	1	7355.78	237.66	0.00
Pre-test	44388.86	1	44388.86	1434.18	0.00
Treatments	935.30	2	467.65	15.11	0.00
Error	7273.40	235	30.95		
Total	997817.00	239			
Corrected Total	53505.16	238			

a = R-square

An examination of Table 2 reveals that $F_{(2, 238)} = 15.11$, at $p < 0.05$ was significant (i.e. < 0.05) Since the $p < 0.05$, there is a statistically significant difference in the achievement in genetics of students taught genetics using different text structures. The null hypothesis which states that there is no statistically significant difference in the achievement of students in genetics when taught using different text structures was rejected.

There is the need to check for the location of the significant difference as illustrated in Table 3

Table 3 illustrates the location of the significant difference in the post-test mean scores of students exposed to different texts structure.

Table 3: Multiple Comparisons of the Mean Score of Students Exposed to Different Text Structures

Treatment (I)	Treatment (J)	Mean Difference (I-J)	SD	Sig ^b	95% Confidence Interval	
					Lower bound	Upper bound
Concept map	Logical prose	0.96	0.87	0.61	-3.04	1.13
	Control	3.72*	0.89	0.00	1.58	5.87
Logical prose	Concept map	0.96	0.87	0.61	-1.13	3.04
	Control	4.68*	0.89	0.00	2.53	6.83
Control	Concept map	-3.72*	0.89	0.00	-5.82	-1.28
	Logical prose	-4.68*	0.89	0.00	-6.83	-2.53

* = The mean difference is significant at the 0.05 level.

The data shows a significance difference in the post-test mean score of students taught with concept map structure and the control in favour of those taught concept map structure. The result also revealed a significant difference in the post-test mean score of students subjected to logical prose and control, in support of the logical prose group. This implies that text structure had effects on achievement of students in genetics.

However, the differences in the post-test mean score of students exposed to concept map and logical prose are not significant.

Research Question 2: Do students with different score levels achieve differently when taught genetics using logical prose?

Students with different score levels achieved differently when taught genetics using logical prose. This is evident from the mean gain scores in Table 4

Table 4: Description of the Achievement of Logical Prose Group with Different Score Levels

Score levels	N	Pre-test (\bar{x})	SD	Post-test (\bar{x})	SD	Mean Gain Score
Low	35	32.89	10.14	51.80	11.24	18.91
Medium	29	53.14	3.62	70.79	6.89	17.65
High	18	69.39	4.12	82.50	6.50	13.11

Table 4 shows that low-scoring students benefitted most with the mean gain score of (18.91), followed by the medium-scoring students (17.65) while the high-scoring students had the least mean gain score of (13.11). The table also reveals a close value of standard deviation 6.50 and 6.89 for medium and high-scoring

students, respectively. This implies that the medium and high-scoring students differ from the mean score with values 6.50 and 6.89, respectively.

Hypothesis 2: There is no statistically significant difference in the achievement of low, medium and high-scoring students taught genetics using logical prose.

To test for the statistically significant difference in the achievement of low, medium and high-scoring students taught genetics using logical prose, Analysis of Covariance was used, and the result was presented in Table 5.

Table 5: The Analysis of Covariance of Mean Scores of Logical Prose Group with Different Score Levels

Source	Type III Sum of Square	df	Mean Square	F	Sig
Corrected Model	15086.76 ^a	3	5028.92	102.39	0.00
Intercept	1296.26	1	1296.26	26.39	0.00
Pre-test	2507.99	1	2507.99	51.07	0.00
Level	103.39	2	51.70	1.05	0.35
Error	3830.87	78	49.11		
Total	368103.00	82			
Corrected Total	18917.62	81			

Table 5 shows that there is no statistically significant difference in the achievement of low, medium and high-scoring students taught genetics using logical prose, at $F_{(2, 78)} = 51.70$, $p = 0.15$. Since $p > 0.05$ the null hypothesis is not rejected.

Research Question 3: Do students with different score levels achieve differently when taught genetics using concept map?

Table 6 illustrates the difference in the achievement of low and medium-scoring students exposed to concept map structure.

Table 6: Description of the Achievement of Low, Medium and High-scoring Students Exposed to Concept Map Structure

Levels	N	Pre-test (\bar{x})	SD	Post-test (\bar{x})	SD	Mean Gain Score
Low	37	35.22	10.99	51.14	13.28	15.92
Medium	37	55.54	4.80	72.11	6.01	16.57
High	9	68.11	1.97	83.56	4.46	15.45

Table 6 revealed that the medium-scoring students benefitted most with a mean gain score of 16.57, followed by the low-scoring students with a mean gain score of 15.92 while the medium-scoring students had

a mean gain score of 15.45. This findings indicated that logical prose favours the achievement of medium-scoring students most.

Hypothesis 3: There is no statistically significant difference in the achievement of low, medium and high-scoring students' taught genetics using concept map.

The result of the test of statistical difference in the achievement of low, medium and high-scoring students is presented in Table 7.

Table 7: The Analysis of Covariance of Mean Score of Low, Medium and High-scoring Students' Exposed to Concept Map Structure

Source	Type III Sum of Square	Df	Mean Square	F	Sig
Corrected Model	17019.47 ^a	3	5673.16	159.92	0.00
Intercept	577.08	1	577.08	16.23	0.00
Pre-test	5021.58	1	5021.58	141.55	0.00
Level	18.11	2	9.06	0.26	0.78
Error	2802.53	79	35.48		
Total	359790.00	83			
Corrected Total	19822.00	82			

The Analysis of Covariance in Table 7 shows that at $F(2, 79) = 0.26$; $p > 0.05$; thus, a statistically significant difference does not exist in the achievement of low, medium and high-scoring students' taught genetics using concept map. Thus, the hypothesis was not rejected.

Research Question 4: What are the interaction effect of text structure and score levels on senior secondary school students' achievement in genetics?

Table 8 illustrates the description of the interaction effects of the text structures and score levels.

Table 8: Description of the Interaction Effects of Treatment and Score Levels

Treatment	Score levels	N	(\bar{x})	SD
Concept map	Low	37	51.65	13.54
	Medium	37	72.11	6.01
	High	9	83.55	4.64
Logical prose	Low	35	52.54	11.10
	Medium	29	70.79	6.89
	High	18	82.50	6.50
Control	Low	36	50.83	6.82
	Medium	30	71.47	4.76
	High	8	81.25	1.16

It could be observed in Table 8 that the high-scoring students in the concept map group, logical prose group and the control had a mean score of 83.55 82.50 and 81.25 respectively. Table 8 also revealed that the

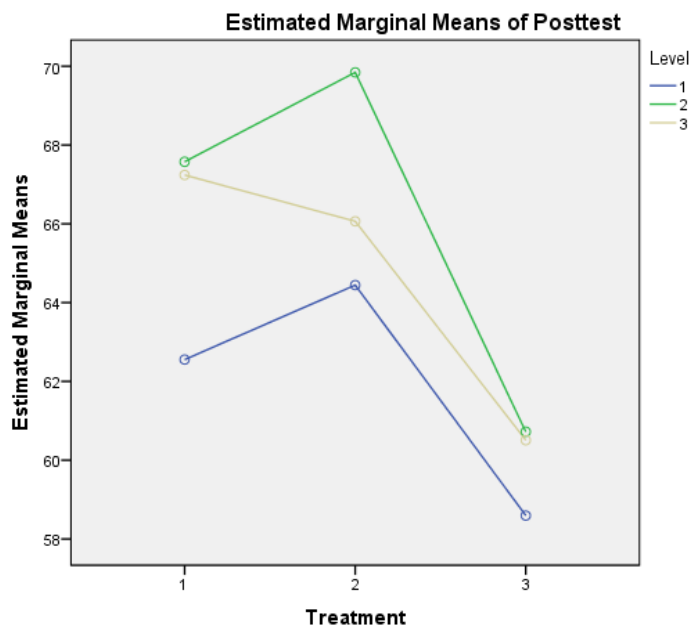
low-scoring students in this group were the least to benefit from the joint effect. This is evident from the mean score of 51.65, 52.54 and 50.83 for the concept map, logical prose and the control respectively.

Hypothesis 4: There is no statistically significant difference in the interaction effects of text structure and score levels on senior secondary school students' achievement in genetics.

Table 9: The ANCOVA of Interaction Effects of Treatment and Score levels

Source	Type III Sum of Square	df	Mean Square	F	Sig
Corrected Model	43262.11	9	4806.90	151.74	0.00
Intercept	2143.74	1	2143.74	67.67	0.00
Pre-test	9361.66	1	9361.66	295.52	0.00
Treatment	17.97	2	8.98	0.28	0.75
Score levels	72.56	2	36.28	1.15	0.32
Treatment *Score levels	159.24	4	39.81	1.26	0.29
Error	7254.47	229	31.68		
Total	1034074.00	239			
Corrected Total	50516.58	238			

Table 9 shows ANCOVA analysis of treatment and score level. Table 9 indicated that there is no statistically significant difference in the interaction effects of text structure and score level; $F(2,229) = 1.26$; at $p > 0.05$. The formulated hypothesis is therefore rejected. This is illustrated graphically in Figure 3.



Covariates appearing in the model are evaluated at the following values: Pretest = 58.30

Figure 3: Graphical Illustration of the Interaction Effects of Treatment and Score levels

Discussion



A significant difference existed among students taught with different text structures. This study established the variation in the effectiveness of the text structures. Students benefitted most from the logical prose structure, which is a form of expository, followed by the concept map while the control group recorded the least achievement. This differs from Idowu's (2008) finding in which the diagrammatic structure had the highest achievement, followed by expository next to the mathematical and the control. The study however corroborated that of Amer (2013) which found that explicit instruction resulted in improving writing performance.

The study also found that there was no significant difference in the score levels of the students taught with logical prose. Though, their descriptive statistics shows that logical structure content was very efficient for the low-scoring students, however the difference was not significant. Next to benefit were the medium-scoring students, while the package was not so efficient for high-scoring students because they have the least mean score.

In the like manner, a significant difference was not found in the achievement of high, medium, and low scoring students taught with concept map, it is important to state that medium scoring students benefitted most, followed by low and high scoring students. As far as this study is concerned, concept map as a form of structuring does not have a good leavening effect that can bridge the existing gap in senior secondary school students' achievement in genetics. This finding agrees with the findings of Adesoji (2008) who found that students' ability had no statistically significant difference in students' performance. The outcome of this study, however, disagrees with the submission of Adeyemo (2010); Adeniran (2010) and Sohn (2013) that academic ability of students had a significant influence on their performance.

On the interaction effect, a significant interaction effect does not exist between text structures and score levels. This implies that text structures and score level did not jointly influence the achievement of students at one level more than the other levels.

Conclusion

The study concluded that logical prose and concept map structures enhance achievement in genetics better than the structure method used by the control group. The study, however, shows that logical prose is more efficient than the concept map. This is because the students exposed to logical prose had higher achievement than the concept map group. The study also concluded that the effect of text structures does not depend on score level for greater achievement by the students and vice versa.

Recommendation

1. Biology teachers could consider logical prose and concept map in structuring the contents of their instruction at the senior secondary school level. Senior secondary school students should also be taught the basic skills involved in the two structures so that they could use the structure on their own for better learning.
2. Senior secondary school teachers should identify the score levels in their class and organize tutorial for them on the development and the use of logical prose and concept map structure. They should

divide students into smaller groups and ensure that every score levels are represented so as to assist sharing of opinion, hence, assist them in better learning.

3. Teachers should be well grounded in the use of logical prose and concept maps and assist their students in updating their knowledge of the text structure as the outcome of their learning is solely due to text structure but not on joint effects.

Limitation of the Study

Non-cooperation on the part of some teachers Despite the intension of the researcher to popularise the text structures and pay them little stipends, most teachers are not willing to cooperate in the training and this is what facilitated the researcher to do some of the teaching. Future researchers' could train the postgraduate teachers to serve as their research assistance and motivate them by paying them for willing to be part of the research.

Time factor is another limitation experienced by this research. Most schools are reluctant to release their class because of the fear that it would prevent them from covering their syllabus. These obstacles were rectified by the Head of the Department of the sampled schools. Each of the unit in the sciences releases some of their class period for the execution of the field work. This made the proposed length of time for the exercise to be feasible.

Sending away defaulters out of the school premises is another factor that tends to obstruct the field work exercise. Future researchers can guide against this by properly study the school calendar before commencement of their study. Guiding against these translate to a smooth field work exercise.

Suggestion for Further Studies

Studies involving more structures such as mathematical, diagrammatical in addition to logical prose and concept maps should be conducted on other difficult biological and science concepts.

The study may be conducted as a mixed research one in which text structures, students' attitude and other socioeconomic factors are incorporated.

Retention level of students could also be added as a dependent variable in future studies.

Studies involving meta-analysis of text structure may be conducted to allow future researchers' evaluate the efficiency of different text structures.

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