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THE EFFECT OF INTERSPERSED QUESTIONS IN TEXTUAL READINGS ON UNDERSTANDING AND RETENTION OF BIOLOGY CONCEPTS BY FORM 3 PUPILS IN FOUR RURAL SECONDARY SCHOOLS IN ZIMBABWE

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Abstract

This study determined the effect of presence of questions in a biology text on recall and retention of concepts by Form 3 pupils. It also sought to determine whether the type of inserted questions influenced this retention. A 1500 word biology text passage was prepared and treated in three different ways before exposure to the target students. In one, the passage was reproduced from the text book (as it was without any inserted questions). In the second, ten factual questions were inserted at different points within the text. In the last, ten application questions were placed at the same points as the factual questions. One hundred and sixty eight (168) Form 3 pupils were sampled from 4 rural secondary schools (42 per school) These were divided into 3 groups (56 each, 14 per school) Each group was made to study a differently treated passage for 40 minutes. At the end of the study period, a common twenty question (multiple choice) test on the passage was administered to all groups to test retention of concepts. Results showed that studying texts in which there are interspersed questions significantly improved pupils' retention of concepts. Higher order questions significantly contributed more to retention than lower order questions. With very minor exceptions, there was no significant difference in the performance of pupils per given variable when inter-school group comparisons were made.

INTRODUCTION

The quest to promote meaningful school learning is the ultimate goal of good teaching. In recent years, numerous teaching aids, apparatus and techniques have been developed for that purpose. Assessment of success in learning, especially in science, has also shifted from placing emphasis on simple acquisition of knowledge to promoting learning that demonstrates knowledge with understanding of scientific concepts, ability to apply information to new situations, analysis, synthesis, judgement, as well as the development of useful experimental and investigative skills. Expansion in application of electronics and computers as teaching tools has done a lot to enhance development of such skills by pupils. Such developments, however, largely benefited developed countries where most of such technologies are developed and are not expensive for schools to procure. With developing nations, because of inadequate access to some teaching/learning tools, much school learning still depends on the textbook. In rural Zimbabwe, for example, the textbook and the occasional handout shall, for many years to come, remain an important source of information to both teacher and pupil. Effective learning from the text will, however, depend on how the text has been designed.

Learning from factual material has been studied and found (Mayer and Gallini, 1990; Loman and Mayer 1983; Watts and Anderson 1971; Hiller, 1974; Ellis et al, 1982) to be influenced by several factors. Such factors include the presence in the textual readings of:

- a) Adjunct questions
- b) Test illustrations
- c) Headings
- d) Instructions
- e) Underlining of key words
- f) Providing of behavioural objectives

g) Presence of summary statements

i) Use of language.

The area of instructional questions and questioning strategies has generated a lot of research. Use of oral questions by teachers during teaching is a much recommended teaching procedure which is known to produce positive effects on achievement (Trowbridge and Bybee, 1986). Questioning in textual reading has also been investigated. In general, questions placed within textual readings have been found to cause significantly higher pupil performance than reading texts without questions (Rothkopf and Bibiscos, 1967, in Ellis et al, 1982). Other researchers (Halpin et. al. 1985, Hiller, 1974, Watts and Anderson, 1971) have shown that presence of high level cognitive pre and post questions in textual readings produced more learning than simple recall questions.

The purpose of this investigation was to determine the effects that interspersed questions in biological text material had on retention of concepts by Form Three pupils. The main areas of focus were to determine:

- whether the presence or absence of interspersed questions significantly affected the pupils' retention of concepts
- whether higher order cognitive questions help students to comprehend and retain more concepts than lower order (factual) questions.

The hundred and sixty-eight (168) Form Three pupils doing Extended Science participated in the investigation. The students were chosen from four rural secondary schools (Mt St Marys, Wedza, and Gumbonzvanda, all in Wedza, and Nyashanu Mission in Buhera. The students' retention of concepts was measured from the scores obtained from a twenty multiple choice question quiz which the pupils answered after studying a 1500 word appropriately treated passage on hormonal coordination. The Dunn multiple t-test and the analysis

of variance test were used to contrast the mean scores of the different groups.

Literature Review

Learning from Textual Material

Psychologists believe that there are two stages or levels of processing information that must occur if a person is to learn from written materials. The first is phonological encoding. This refers to verbatim storage of printed verbal stimuli. Here, the student learns by 'rote' a string of words without creating meaning to himself. However, on being tested, the student is able to recall or reproduce the rote learnt information. The second type of processing is semantic encoding. This requires that the learner remembers the meaning as well as physical features of the text. In such a situation, the learner understands the material and can identify instructional statements correctly if presented in a form substantively different from the one initially learnt. Semantic encoding therefore brings to mind meaningful representations of words (Cronbach, 1963). It entails development of mental "images" of things and events named by the words.

A good text should be accompanied by procedures that induce the reader to comprehend words than merely reproduce them. Bobrow and Bower, (in Greme and Watts:1971) from their experiments on effects of textual structure, concluded that students generally benefitted more from texts that included: a) headings and illustrations, (b) pictures and inserted questions. Cronbach (1963) on effective communication of knowledge using texts suggests among others, (a) questions interspersed within text, (b) appropriate use of language, (c) improved organization (use of headings, objectives, summaries) and (d) visual devices. Loman and Mayer (1983), on increasing understandability of expository prose, suggest signaling techniques (preview sentences, underlined headings and logical connective phrases). All these procedures, if used in designing texts, are known to induce readers to comprehend and retain as well as recall concepts better. Other researchers: Mayer (1990), Ellis et. al. (1982) and Halpin et. al. (1985), in considering the effects of illustrations in scientific texts,

adjunct, post questions and instructions, and higher order and lower order questions respectively have reported positive results on semantic encoding. Such procedures assist students to perform better in problem solving.

Retention

One means of determining if semantic encoding has taken place is to test retention. Meaningful learning occurs when information from the text is processed and stored in the brain. A measure of the cognitive outcomes is necessary to find how much learning has occurred from the text. André (1979) suggested two types of memory probe 'tests'. The first probes episodic memory - questions about particular events. The second probes semantic memory (general decontextualised knowledge). Both of these activate backward mental review operations and thus are a measure of retention. Apart from these, other memory probes (which may be viewed as subsets of the former) may be used. These included: multiple choice, fill in, inferential items and essays. All can measure cognitive achievement.

Effects of Subheadings, Text Illustrations, and Pictures on Retention

Pictures and illustrations have a supplementary role on understanding of text (Mayer and Gallin, 1990). They help learners visualise specific events (such as not commonly found in narrative passages) and thus become able to organise information into a coherent structure through interpreting the illustrations.

Text understanding is also enhanced through use of signals or signposts (subheadings, preview sentences, connective phrases and underlining). Such signals (Loman and Mayer, 1983) modify students' reading strategies by making conceptual organisations and causal links in the passages more obvious.

Interspersed Questions : Types and Influence

Questioning remains one of the most influential and commonly used teaching techniques. Research on the questioning behaviour of teachers (Trowbridge and Bybee, 1986) reveals that teachers mostly use questions during verbal discourse. Questions stimulate memory recall and student participation. Questioning level has direct influence on cognitive growth of pupils.

Generally, questions asked by teachers fall into two levels. According to Bloom's taxonomy, these can be referred to as low order and/or high order questions. Alternatively, they are convergent and/or divergent questions respectively. High order/divergent questions tend to promote cognitive growth which, in increasing hierarchy, shows knowledge, comprehension, application, synthesis and evaluation. Low order questions are largely limited to recall of knowledge. During verbal discourse, higher order questions are more desired because answering them leads to greater achievement than answering lower level questions. They encourage more answers or provide wider responses which are more creative and critically thought thus enhancing the pupils' self concept. Pupils whose teachers ask higher order critical thinking questions also performed better in science achievement tests than those taught by teachers asking questions requiring simple recall (Rosenshine in Trowbridge and Baybee, 1986). There seems to be a significant relationship between frequency of use of higher order questions in verbal discourse and pupil performance. When teachers use proportionally higher order questions than low order, (Ladd, 1969, in Trowbridge and Bybee), pupils significantly show greater improvement in achievement in test composed of both low and high order questions.

In determining the learning enhancing effect of questions in texts, Rothkopf (Graeme et. al., 1971) placed questions within a text and examined pupils' memory of the text on a final criterion test. Results showed that students learn more from prose passages when they are frequently required to answer questions within the text. One reason to explain this is that adjunct questions influence the learners' perception of the task thereby altering their encoding of the ensuing text. The questions either direct the readers' attention to specific information within the text or more generally heighten their attentional

level to all material. This adjusted study behaviour (Hiller, 1974) enables the learner to more clearly define the desired learning outcomes.

Ellis et al (1982) examined the effect of using post question in textual material on student performance. Their results showed that the experimental groups performed significantly better on a final test criterion than the control groups. Post text questions have both direct and indirect positive effects on readers. The direct effects are due to the fact that the post text questions and the test question may be informationally similar or identical. Since the questions (post test) may alert the learners on the information that was to be learnt from the text, they are more 'forward' prepared for the test. Pupils reading passages with past questions are more 'mathemagically' able to figure out what the final test will be like (i.e. form hypotheses about what's important to learn - thus focusing information processing). The indirect effect of post questions has been given as their tendency to make the students learn information other than that covered by the questions.

Haipin et al, 1985, Watts et al, 1971, Hiller, 1974, looked at the effect of different types of questions in textual material on pupil learning. Halpin et al determined the effect of presence of high and low order questions in texts on pupil attention as measured by their reaction to auditory probes. The results showed that pupils reading passages with higher order questions pay significantly more attention. They therefore show longer reaction times than those reading passages with low order questions. It was also found that recall from passages with higher order questions was significantly better than from low order. These findings have been explained in terms of the differential effects of the question types on the readers. Higher order questions require more extensive cognitive operations (recall, subssumption, analysis, synthesis, etc) than lower order questions. Readers tend to attend more in answering them than when answering low order questions. Higher order questions also require learners to attend to larger amounts of information in memory than low order questions - as reflected in the disparity of reaction times of pupils formulating answers to the two types of questions.

Watts and Anderson (1977) studied the effect of three types of questions (application, name recall and repeat example questions) on learning. They found that application questions (higher order) cause pupils to significantly perform better than the others. This is so because with application questions, learners are forced to go beyond literal content of the instruction by processing the material further therefore learning more. Hiller (1974) compared the effects of readability level of texts, inserted question difficulty and learner individual differences on retention of incidental concepts from textual material. His results showed that when students study passages of below average readability that have been treated with 'hard' and 'easy' questions, acquisition of information incidental to both types of questions is significantly reduced. With texts that are of average readability level, only hard questions significantly reduced incidental learning. Lower than average readability level texts significantly lower incidental learning because difficult learning material evoke (Wine, 1971, In Hiller, 1974) distracting emotional behaviours. This is particularly so if individual differences of pupils (anxiety and confidence) are considered. Generally, pupils with low grade point averages have lower success expectations thus tend to perform significantly more poorly than those with high grade point averages when made to study passages of low readability level. With regard to reduced incidental learning due to high question difficulty, pupils studying the average readability text tend to concentrate more on question related material during reviewing of the text. This leads them to miss incidental concepts.

Finally, research has also been carried on effect of position of questions in texts on learning (Halpin et al, 1985). Generally, when questions are placed before text, they provide learners with a 'phonological target' on which to expand his/ her search activity. On the other hand, when questions follow text, the learners attempt to reprocess and store the general context and hence remember the semantic structure rather than simple verbal units. It's also possible that readers expecting post questions have increased vigilance during reading. As regards position effect of both low and high order questions in text, it has been found (Reynolds and Anderson in Ellis et. al. 1982) that attention effects occur during the reading of

text-relevant content appearing subsequent to questions. In general, analysis of most science texts used in schools shows a preference for post text questions over pre-text and interspersed questions.

This review has highlighted some factors that are known to have influence on students' learning from textual material. Questions associated with the text have been shown to have various effects. This investigation specifically sought to determine the effect of interspersed question on retention and recall of biological concepts by form 3 pupils. It also sought to determine if there were differential effects on recall and retention if higher and/or low order questions were inserted in passages.

HYPOTHESIS

Before the investigation was carried out, it was hypothesized that:

1. Students reading a biological text that did not have any interspersed questions would comprehend and retain less from that text than students reading the same passage in which interspersed questions are inserted.
2. Students reading a biology text with factual interspersed questions would comprehend and retain less from the passage than those who read the same text with application questions inserted.
3. There is no significant difference in performance of groups reading similarly treated texts in different schools.

METHOD

Sample

One hundred and sixty-eight (168) from three pupils from four rural secondary schools participated in the exercise. The schools involved were Gumbonzvanda, Mount Saint Marys, Wedza (all in Wedza District) and Nyashanu in Buhera. Nyashanu and Mt. St. Marys have boarding facilities while the other two are day schools. All pupils were enrolled in the Extended Science course. This course is mainly offered to those pupils who obtain top grades in Science and Mathematics in their junior certificate courses. The average age of the students was sixteen. The sample consisted of 138 boys and 30 girls. Each school contributed 42 (a class) pupils who, for the purposes of the exercise, were randomly divided into 3 groups of 14 pupils each.

Material

The Biology text to be studied by the pupils was extracted from a popular O-Level biology textbook: Makean D. G. (1984) *Introduction to Biology*. The text represented a short chapter which is part of the textbook's unit on coordination. It discussed concepts of sources, types, transport, effects and functions of hormones. All original illustrations and subcaptions were excluded from the text. This ensured that only one variable, i.e. interspersed questions, was tested. The whole passage (text) was about 1 500 words long.

For treating the passage, two types of questions: factual and application (in equal numbers) were selected from literature and past exam papers. All the questions tested comprehension of issues discussed in the text.

For testing recall and retention of concepts, 20 multiple choice questions (an equal mix of low and high order) was prepared. This was administered to all the 42 pupils per school soon after they finished studying the passage.

TREATMENT OF GROUPS

Group A: Control - No Questions

The passage was retyped as it was from the text (without diagrams and subheadings). No interspersed questions were added. In all 14 pupils per school or 56 pupils (all schools) read and studied the passage individually for 40 minutes. After studying, they were given the 20 multiple choice question test.

After marking, the groups' performance was compared with that of others who had studied differently treated texts. This was done to see whether there was any significant difference in the mean scores obtained by each of the three groups. The 'ANOVA' Analysis of Variance test was used. Secondly, the students' t-test was used to compare and find out if there was any significant difference between individual schools' performance after studying the passage.

Group B: Factual Question

The same passage as in A was used. Ten factual questions were interspersed within it. Fifty-six students, (14 at each school) read and studied it individually for forty minutes before writing the 20 multiple choice question test as in A. After marking, statistical tests in A were also applied to see if there was any statistical difference between mean scores of control and the factual and to see whether interspersed factual questions enhanced understanding better than application. The student t-test was also applied to determine any significant difference in performance between individual schools.

Group C: Application Questions

The passage was retyped as for Group B. Ten application questions were interspersed within it - substituting factual questions. As with texts A and B, 56 students (14 per school) studied the passage for 40 minutes. Students were advised to note the questions. They were, however, not to write down any answers to the inter-spersed

questions. After studying the passage students were tested for their concept retention using the same 20 multiple choice questions as with groups A and B. Their average scores were treated as follows:

i) compared with those of Groups A and B to find if there were any significant differences between the three groups (F-test);

ii) compared with Group B to see if there was any significant difference between effects of factual and application questions on pupil achievement (F-test);

iii) the student's t-test was also applied to determine any significant difference in performance on the variable school by school.

RESULTS

MULTIPLE CHOICE-ROW SCORES OBTAINED BY STUDENTS STUDYING DIFFERENTLY TREATED TEXTS

TABLE 1

SCHOOL	PUPIL	A CONTROL (NO QUESTIONS)	B FACTUAL QUESTIONS	C APPLICATIONS QUESTIONS
	1	8	17	14
	2	12	13	15
	3	10	13	15
	4	9	13	14
	5	10	13	12
	6	12	10	14
1	7	9	14	15
	8	9	13	12
	9	12	10	15
	10	13	15	14
	11	12	13	15
	12	9	13	10
	13	12	9	15
	14	10	12	14

MEANS		10.500	12.7143	13.8571
	1	10	10	11
	2	9	14	15
	3	13	9	15
	4	12	13	14
	5	9	13	15
	6	10	15	15
2	7	9	10	14
	8	9	10	10
	9	13	14	14
	10	8	14	15
	11	10	10	14
	12	12	13	15
	13	13	13	13
	14	9	7	13
MEANS		10.4286	12.5000	13.7857

SCHOOL	PUPIL	A CONTROL(NO QUESTIONS)	B FACTUAL QUESTIONS	C APPLICATION QUESTIONS
	1	12	10	6
	2	8	7	9
	3	10	13	12
	4	10	11	10
	5	9	6	14
	6	9	8	13
	7	10	10	12
3	8	13	13	10
	9	12	11	15
	10	9	12	13
	11	10	14	13
	12	5	12	9
	13	14	10	12
	14	8	7	11
MEANS		9.9286	10.2857	11.3571
	1	10	8	13
	2	6	14	14
	3	10	10	14
	4	12	11	10
4	5	7	12	13
	6	10	14	14
	7	8	9	13
	8	9	8	14
	9	11	13	12
	10	10	13	10
	11	15	9	14
	12	9	12	14
	13	14	12	13
	14	8	16	14
MEANS		9.9286	11.5000	13.000

KEY

- 1 = Mt. St. Marys Secondary
 2 = Nyashanu Secondary
 3 = Gumbonzvanda Secondary
 4 = Wedza Secondary

TABLE II

**MEANS AND STANDARD DEVIATIONS FOR GROUP TOTALS
 FROM ALL SCHOOLS**

VARIABLE	NO. OF STUDENTS (N)	MEAN MEAN X	STANDARD DEVIATIONS (SD)
A NO QUESTIONS	56	10.1964	2.040
B FACTUAL QUESTIONS	56	11.7500	2.473
C APPLICATION QUESTIONS	56	13.0000	1.991

Mean performance after studying the biology text was positively influenced by the presence of questions in the text. Higher order questions produced higher means and lower standard deviations than lower order or factual questions.

a)

TABLE III (F-TEST)

SOURCE OF VARIATION	SUM OF SQUARES	DEGREE OF FREEDOM	MEAN SQUARE	F VALUE	SIGNIFICANCE
Factual vs No Questions					
Explained	23.789	11	2.163	0.464	0.91
					(11/44)
Residual	2050	50	44	4.6	60
Total	228	839	55	4.1	61

At 11/44 degrees of freedom (df), the calculated value $F = 0.464$ is much lower than critical value of $F (=2.73)$ from statistical tables. At 99% or 0.01 confidence limit, there is a highly significant difference in retention of concepts between pupils reading the no question passage and those reading the passages in which factual questions are interspersed.

b)

No Questions vs Applied Questions	sum of squares	Degree of freedom	mean square	f value	significance
Explained	15818	7	2.260	0.509	0.82 (7/48)
Residual	213	48	4.438		
Total	228	55	4.161		

At 7/48 degrees of freedom (df) the calculated F-value (0.509) is smaller than the critical value of $F(5.86)$. At 0.01 (99%) confidence limit, there

is a highly significant difference in retention of concepts between pupils studying the non questioned text and those reading the text in which higher order questions are inserted.

c)

Factual Vs App Lied Questions	Sumof Of Square	Degreesof Of Freedom	Mean	F Value	Signi- Ficance
Explained	70.803	15	4.720	0.906	57 (57/40)
Residual	158.036	40	3.951		
Total	228.839	55	4.161		

With 14/40 degrees of freedom (df) the calculated value of F(0.906) is lower than the critical value (cv) of F(3.13) at 0.01 (99%) confidence limit; there is a significant difference in retention of concepts between pupils reading text treated with factual questions and those studying the text in which higher order or application questions have been included.

At 13 degrees of freedom (see appendix Table III (T-Test)), and probability (p) value of 0.01 (99%) the critical value (cv) of T is 3.012 for all comparisons. In all cases, the calculated T value is consistently lower than 3.012 (i.e. .11, .77, .85, .00). At 99% confidence limit, these results show that there is no significant difference in the T-test groups' retention of concepts when pupils study texts in which there are no interspersed questions.

At 13 degrees of freedom (df), and probability (p) value of 0.01 (99%) the critical value (cv) of T is 3.012 for all test groups. With the exception of test groups 1.3 and 2.4, the calculated T-value remains below the critical T-value. At 99% confidence limit, significant difference in interschool performance on the factual questioned text exists for schools 1 and 3 and 2 and 4. For the rest; there is no significant difference in performance. (see Table IV(T-Test))

At 13 degrees of freedom (df) and 0.01 p-value, the critical value (cv) of T is 3.012 for all test groups. With the exception of test groups 1.3 and 2.3, the calculated T-value are consistently lower than 3.012. At 99% confidence limit, there is no significant difference in interschool performance for pupils studying the application questioned text except for school 1 and 3 and 2 and 3. (See Appendix Table V (T-Test))

DISCUSSION AND CONCLUSION

The research aimed at:

- i) determining whether inserting questions in a biology text caused significant gains in test scores of pupils reading or studying the text.
- ii) Determining whether the level of question difficulty associated with the text significantly affected the amount of learning that took place. It also compared interschool performance per given variable to find if there were any significant differences in retention of concepts.

Statistical analysis (ANOVA) of the test scores revealed the following pattern:

- i) Mean test scores improved when the pupils studied passages in which there are interspersed questions.
- ii) Higher order questions contributed more to higher mean test scores than factual or low order questions.
- iii) Interspersing questions in the biology text did have a highly significant effect on pupil performance. The degree of improvement corresponds with question difficulty.

iv) On the biology text, with no questions, there was no significant difference in interschool test performance. With questions inserted, interschool performance per variable (low order/high order) was of a mixed nature. Between some pairs, there is a significant difference while between others there isn't any.

These results are in agreement with the stated hypotheses, i.e. that interspersing questions in texts improved pupil performance and that higher order questions have a more positive influence than lower order questions. The findings are also in agreement with most reported in literature (Watts et al, 1971, Halpin et al, 1985, Hiller, 1974, Loman and Mayer, 1983, Ellis et al, 1982).

In general, presence of questions in texts could have influenced the adjustment of the pupils study behaviour by raising their attentional level (Hiller, 1974) thus promoting more semantic encoding (Cronbach, 1963). It's also possible that the thinking and recall process required in the final test had been preempted by presence of interspersed questions (Ellis et al, 1982). This forward preparation thus made affected pupils more 'mathemagenically' able to figure the nature of the final test and thus retain more from the text. Regarding difference in performance between lower and higher order questioned texts, the more involving nature of the higher order questions (Halpin et al, 1985) required the students to attend to the task more closely thus promoting more semantic encoding than in those studying the text with lower order questions. Without questions in the text, pupils are not forward prepared because encoding is then more phonological than semantic. If test does require more than verbatim recall of the text, the retention measured could be less.

Regarding differences in interschool performance on factual and application questioned texts, two factors could have influenced results. First, the highest featuring school regarding significant differences in paired comparisons was 3 (3 times). School 3 and 4 are day schools while 1 and 2 are boarding schools. Possibly as Wine (1971) in Hiller, 1974 asserts, the nature of their learning environment creates greater anxiety and less confidence when faced with new tasks

as in this case. Anxiety and limited confidence are distractors to gainful learning. Secondly, teaching approaches commonly used by teachers of science in the schools could have been an influence. Where teachers are known to use questioning frequently during verbal discourse (Trowbridge and Bybee, 1986), pupil performance is significantly better than where questioning is rare. In these schools, (although not investigated), it's possible that the degree to which teachers used the questioning technique and the type of questions they frequently asked during verbal discourse could have contributed towards the differences observed in interschool performance on factual and application questioned texts. Other factors could be the nature of textual materials used in the schools, the qualifications of the teachers, their assessment methods and how frequently used and the type of school.

From the results, it is apparent that presence of interspersed questions in biology text and the level of difficulty of such questions did significantly influence the amount of learning from the texts. Learning from biology textbooks and other teaching materials for both junior and high school pupils could be more effective if interspersed questions are included.

REFERENCES

1. Andre R. (1979): Does Answering Higher Level Questions While Reading Facilitate Productive Learning? *Review of Educational Research*, Vol.40, 280-318.
2. Bailey N. T. J. (1988): *Statistical Methods in Biology*, Hodder and Stoughton, London.
3. Cronbach L. J. (1963): *Educational Psychology*, Brace and World Inc., New York.
4. Ellis J. A. et al (1982): Comparative Effects of Adjunct Post-questions and Instructions on Learning From Text. *Journal of Educational Psychology*, Vol 74, No. 6.

5. Halpin D. R. et al (1985): Differential Effects of Higher and Lower Order Questions: Attention Hypothesis. *Journal of Education Psychology*, Vol. 77, No. 6.

6. Hiller J. H. (1974): Learning from Prose Text - Effects of Readability Level, Inserted Question Difficulty and Individual Differences, *Journal of Education Psychology*, Vol. 66, No. 2.

7. Hinkle D. C. et al (1988): *Applied Statistics For the Behavioural Science*, Houghton Mifflin Company, Boston.

8. Loman N. L. and Mayer R. E. (1983): Signalling Techniques that Increase the Understandability of Expository Prose, *Journal of Education Psychology*, Vol. 62, No. 6.

9. MacKean D. G. (1974): *Introduction to Biology*, Murray, London.

10. Mayer R. W. and Gallin J. K. (1990): When Is an Illustration Worth Ten Thousand Words? *Journal of Education Psychology*, Vol. 82, No. 4.

11. Norrusion M. J. (1988): *The SPSS Guide To Data Analysis for SPSS*, SPSS Inc.

12. Trowbridge L. W. and Bybee R. W. (1986): *Becoming a Secondary School Science Teacher*, Merrill Publishing Company, London.

13. Watts G. H. and Anderson R. C. (1971): Effects of Three Types of Inserted Questions on Learning from Prose, *Journal of Education Psychology*, Vol.

TABLE III (T-TEST)

TWO WAY COMPARISON IN PERFORMANCE OF SCHOOLS ON THE NO QUESTIONS TEXT

COMPARED SCHOOLS	NO OF STUDENTS	MEAN SCORES	STANDARD DEVIATION	MEAN DIFFERENCE	STANDARD DEVIATION	T. VALUE	DEGREES OF FREEDOM	CRITICAL T. VALUE	VALUE OF P
1	14	10.5000	1.605	.0714	2.433	.11	13	3.012	0.01
2	14	10.4288	1.785						
1	14	10.5000	1.605	.5714	2.766	.77	13	3.012	0.01
3	14	9.9288	2.303						
1	14	10.5000	1.605	.5714	2.766	.77	13	3.012	0.01
4	14	9.9288	2.303						
2	14	10.4288	1.785	.5000	2.565	.73	13	3.012	0.01
3	14	9.9288	2.303						
2	14	10.4288	1.785	.5000	2.210	.85	13	3.012	0.01
4	14	9.9288	2.495						
3	14	9.9288	2.303	.0000	2.481	.000	13	3.012	0.01
4	14	9.9288	2.303						

TABLE V (T-TEST)

TWO WAY COMPARISON IN PERFORMANCE OF SCHOOLS ON THE FACTUAL QUESTIONS TEXT

COMPARED SCHOOLS	NO OF STUDENTS	MEAN SCORES	STANDARD DEVIATION	MEAN DIFFERENCE	STANDARD DEVIATION	T. VALUE	DEGREES OF FREEDOM	CRITICAL T. VALUE	VALUE OF P
1	14	13.8571	1.512	0.0714	2.093	0.13	13	3.012	0.01
2	14	13.7857	1.578						
1	14	13.8571	1.512	2.5000	2.473	3.78	13	3.012	0.01
3	14	11.3571	2.373						
1	14	13.8571	1.512	0.8571	2.214	1.45	13	3.012	0.01
4	14	13.0000	1.414						
2	14	13.7857	1.578	2.4288	2.138	4.25	13	3.012	0.01
3	14	13.3571	2.373						
2	14	13.7857	1.578	0.7857	2.259	1.30	13	3.012	0.01
4	14	13.0000	1.414						
3	14	11.3571	2.373	-1.6429	2.951	-2.08	13	3.012	0.01
4	14	13.0000	1.414						



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