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**Effect of Coherence Design Principles on Students' Academic Performance and Interest**

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Coherence design,  
Text-based design,  
Computer studies,  
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**Abstract**

A quasi-experimental study was carried out to examine the effect of coherence design principles on the interest and performance in computer studies among senior secondary school students attending private secondary schools in Obio-Akpor Local Government Area of Rivers State. A sample size of four hundred (400) students was selected using purposive sampling technique. A 10-item semantic scale questionnaire and a 20-item performance test questions titled computer studies students' performance test were designed by the researcher were used to assess interest and performance among the students. Research questions were answered using mean and standard deviation, The Analysis of Covariance was used to test the hypotheses. Findings of the study revealed that coherence principle enhanced students' interest when compared to text-based design, however, further analysis revealed that the difference in the mean performance scores of students taught using coherence design principles and those taught using text based design was not statistically significant. Based on the findings, it was recommended amongst others that workshops and conferences to encourage the use of instructional slides when appropriate and adopting the principles should be inculcated at the secondary school level.

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**Introduction**

The principle of coherence explains that when foreign (irrelevant) materials are excluded instead of included in a presentation slide, people learn to create more meaning from an instructional slide. This means that designs or diagrams that are not meaningful or useful to the content should be eliminated during a slide presentation. The removal of foreign materials that could trigger distractions helps the learners focus more on the essential materials.

Text-based presentation can be compared to the teaching method of lecture, they are fantastic ways to portray knowledge in either tabulated or bulleted form visually. Without any link to real life experience, the material on the slides will be based on a listing format. Instructions are presented during the presentation in accordance with the material in the bullet point, whether it is familiar to the learners or not. Apparently, learners listen without providing any audio or visual assistance other

than text that could support or aid the learners' cognitive process throughout the presentation. Presentation is an aspect of instructional delivery where, by establishing a framework for sequencing and arranging material, content is separated into slides. As the most widely used type of visual aid, Microsoft PowerPoint is possibly known. If well used, however, it can really help to summarize broad content while still retaining meaningful concepts. In addition, it may have the opposite effect if used wrongly. This explains that the way and manner by which contents are displayed using power point slides can either improve or cause a decline in students' performance and arousal of interest of the audience/learners. The intrinsic cognitive mechanisms involved in human learning and knowledge understanding can be improved by an efficient design of presentation slides. Efficient designs help learners take care of relevant material, arrange and incorporate it with prior knowledge into coherent mental representation. Poorly crafted presentation slides can overwhelm and confuse students, resulting in a performance decline. Effective instructional presentation can be seen as a collection of skills that allow a teacher to communicate with the students, express the messages clearly, and engage the students during presentations. Good and meaningful instructional presentation slides can enhance the skills of the learners in refining cognitive processing skills, thereby improving interest and performance

Interest was explained by Harackiewicz, et al., (2016) as a powerful motivational process that energizes learning, directs academic and career paths, and is central to academic success. Interest is both a psychological state of focus and affection for a specific object or subject, as well as a permanent predisposition over time to re-engage. It can be deduced from the above description that a learner's interest, when maintained, has a significant influence on the learner's performance. In other words, when the interest of the learners can be gained and sustained, performance success is inevitable.

Performance is assessed by ratings, generally measured by tests or ongoing evaluations, although there is no universal consensus about how best to assess it or which elements are most relevant. Other viable variables can affect academic performance, such as rewards, teaching style, individual differences, academic socialization of parents, cognitive factors, and non-cognitive factors. As seen by Abakpa et al., (2016), success in the academic sector could be seen as the level of achieving set teaching goals. This implies that for every performance, there are set objectives to be achieved or met before it could either be declared good, excellent or poor performance. Similarly, Nwanekezi (2018) explained that academic performance is often tied to students' performance in an examination which may be conducted by the West African Examination Council (WAEC) and National Examination Council (NECO). This implies that it shows the level to which learning has taken place in a learner in addition, Nwanekezi clarified that success aims to quantify an improvement in a student's knowledge resulting from engaging in a learning activity or event. The success of students remains a top priority for educators and is expected to make a difference locally, regionally, nationally, and internationally. Educators, trainers, designers of educational programme and curriculum planners have long been involved in exploring variables that can effectively lead to improving the performance of learners. In the pursuit of the above, Computer Studies educators are not left out as this discipline, or subject lays a foundational knowledge prerequisite for every 21<sup>st</sup> century citizens and learners. The most important aspect of computer studies is problem solving which is an essential skill for the 21<sup>st</sup> century learners. In computer studies, students study the design,

development, analysis and uses of software and hardware's used to solve problems. The increasing value of computer studies in recent times makes the search for design strategies that can improve secondary school students' interest and performance in computer studies to inculcate the necessary skills due for the 21<sup>st</sup> century learners quite important. The study was carried out to assess the effects of coherence design principles on students' academic performance and interest.

## Literature review

### Coherence design principle

The Coherence Principle asserts that humans learn best when there is no unnecessary, distracting content present. Simply put, eliminate the excess, use only the data that the learner requires. Most of the time, this means using simple language and graphics that are directly related to the learning topic. The coherence principle refers to the removal of words, audio and graphic that does not support instructional goals. This principle assumes that the learning process is hindered when learners' working memory is overloaded with seductive details that do not contribute to the learning goals. Based on the cognitive theory of multimedia. Coherence principle summarily implies that in lesson presentations, materials that does not support the instructional goal should be avoided. However, as important, and straight forward this principle appears, it is also commonly violated. The application of this coherence principle can have a strong impact in learning as explained by Mayer and Moreno (2004). In Mayer and Moreno explanation, the term weeding was used to refer to the need to uproot word, graphics or sounds that are not essential and central to the goal of the lesson or instruction. Irrespective of the importance of the coherence principle, instructional content designers might be tempted to enrich lessons with relevant and extraneous visuals that might seem needed to sustain the interest of learners, or that can help keep learners engaged. The aforementioned is mostly common or encountered in the e-learning space. For example, in order to counter high e-learning dropout rates, some designers attempt to spice up their materials by adding entertaining or motivational elements such as dramatic stories, pictures, or background music. Coherence principle discourages such practice.

Coherence principle can be divided into three stages: avoiding lessons/e-lessons with extraneous audio, avoid lessons/e-Lessons with Extraneous Graphics and avoid e-Lessons with Extraneous Words

### Coherence Principle 1: Avoid Lessons with Extraneous Audio

#### Coherence Principle 1

- Avoid e-Lessons with Extraneous Audio
- Evidence suggests learning is better when sounds and music are excluded.
- Example of extraneous audio:

*How to Tie a Perfect Victoria Knot*

<http://www.youtube.com/watch?v=D9Z8nelaDu0&feature=related>

*How to Tie a Scarf Into an Ascot Using a Leopard Print Oblong Scarf*

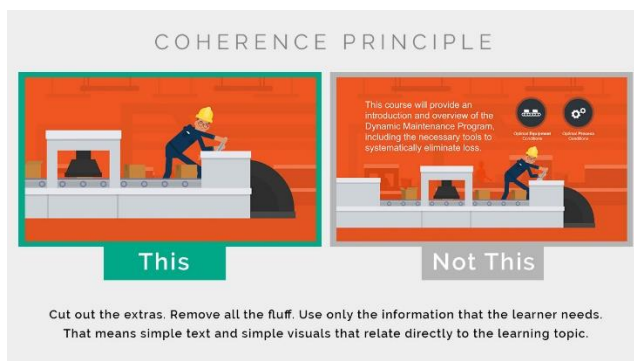
<http://www.youtube.com/watch?v=ktm0w1427Sw&feature=related>

Coherence principle based the design principles of avoiding or eliminating extraneous audio on the principles of psychology of learning and based on understanding the principles on how people learn from words and pictures. Coherence principle explains that the presence of background music and sounds may lead to an overload in the working memory thereby leading to cognitive overload. A typical example or research evidence can be found in the work of Mayer 2011 in a review of twelve award-winning instructional software products this research found that The Coherence Principle notes that all unnecessary details in the multimedia communications, such as sound, picture and other content, should not be included in the presentation and that extraneous elements can distort learning, as further opined by Cheta (2013), presentation slides should be censored in other to ensure that no irrelevant elements are added and also, during presentation or content delivery, one should not be introduced. This explains that some extraneous images or graphics are added to slides for mere beautification or making the slides catchy, coherence principle do not support such design strategy, stating that it sometimes leads to distractions and create noise in the design. According to the Cognitive Theory of Multimedia, the capacity of human memory is very small. It envisages that adults will learn deeply from multimedia presentations which do not contain extraneous sounds. This means lessons or slides that do not contain contents that are not relevant to the instruction.

### Psychological Reasons to Avoid Extraneous Audio in Learning

The cognitive theory of multimedia learning, which assumes that working memory capacity is severely constrained, provides a theoretical justification for not including music and sounds in multimedia presentations. The narration and the extraneous sounds must contend for limited cognitive resources in the auditory channel because background sounds can overload and impair the cognitive system. Learners are less able to pay attention to the narrative outlining the important phases in the explanation when they are distracted by sounds and music. According to the cognitive theory of multimedia learning, students will learn more thoroughly from multimedia presentations that don't include distracting sounds and music than from multimedia presentations that do.

### Coherence Principle 2: Avoid Lessons with Extraneous Graphics



This principle states that adult learners can wish to read contents on-screen in mental structures or pictures. A picture taken should supplement the thinking processes of learners and not distract students. Avoid adding extraneous pictures. This recommendation does not mean that interesting graphics are harmful in all situations. Rather, they are harmful to the extent that they can interfere with the learner's attempts to make sense of the presented material. Extraneous graphics can

be distracting and disruptive of the learning process. when pictures are used only to decorate the page or screen, they are not likely to improve learning as an example, in the figure above, the diagrammatic illustration that the first slide on the left tagged (this) is in line with coherence principle in this slide, extraneous images, visuals were eliminated. While in the right slide of the diagram tagged (Not this) revealed that extraneous graphics was found displayed in the slide. In reviews of science and mathematics books, most illustrations were found to be irrelevant to the main theme of the accompanying lesson (Mayer, 1993; Mayer et al., 1995). We recommend excluding this type of information

### Psychological Reasons to Avoid Extraneous Graphics in Learning

According to the cognitive theory of multimedia learning, the learner is actively seeking to make sense of the presented material. If the learner is successful in building a coherent mental representation of the presented material, the learner experiences enjoyment. However, adding extraneous pictures can interfere with the process of sense-making because learners have a limited cognitive capacity for processing incoming material. According to Harp and Mayer (1998), extraneous pictures (and their text captions) can interfere with learning in three ways: Distraction by guiding the learner's limited attention away from the relevant material and toward the irrelevant material, Disruption by preventing the learner from building appropriate links among pieces of relevant material because pieces of irrelevant material are in the way, and Seduction by priming inappropriate existing knowledge (suggested by the added pictures), which is then used to organize the incoming content. Thus, adding interesting but unnecessary material including sounds, pictures, or words to e-learning can harm the learning process by preventing the learner from processing the essential material. The cognitive theory of multimedia learning, therefore, predicts that students will learn more deeply from multimedia presentations that do not contain interesting but extraneous photos, illustrations, or video.

### Coherence Principle 3: Avoid Lessons with Extraneous Words

#### Coherence Principle



This principle states that simple, basic, and concise on-screen text helps learning. Therefore, We should avoid using time-consuming phrases and sentences and instead help the learner by using sounds sparingly, adding complementary images and simple and concise on-screen content.

Applying the concept of coherence should make the course effective and concise. Designers, we should focus on stimulating learners' interest and improving performance without the addition of foreign materials (Mayer, 2008).

## Psychological Reasons to Avoid Extraneous Words in Learning

For the same reasons that extraneous sounds and graphics can be distracting, adding extra words can interfere with the learning process. We address three types of extraneous wording. First, additional words may be added for interest. The extra words are related to the topic but are not relevant to the primary instructional goal. Second, extra words may be added to expand upon the key ideas of the lesson. A third purpose for extra words is to add technical details that go beyond the key ideas of the lesson. Subject-matter experts like to incorporate considerable amounts of technical information that expands on the basics. We recommend against extraneous words added for interest, for elaboration, or for technical depth. The coherence principle will help you create a more effective and concise course. As designers, we should concentrate on piquing pupils' interest while avoiding the use of distracting items. The instruct plate out a method to include more intriguing words and improve personalization. Some schoolers have explained their output on the use of coherence design principle, In a study by Shin, Choi, Stevens, and Krajcik. (2017). that explored the influence of a coherent curriculum as a systematic approach to aligning and sequencing specific ideas to support students in developing deeper knowledge of chemistry core ideas by comparing students in classrooms that used coherent instructional materials with those that used more traditional materials. We followed approximately 1225 middle school students from 6 schools in 4 different states over 4 time points, across 2 school years, and across 3 grade levels. 165 assessment items were used to measure student understanding along a learning progression, which provides a guide for how students may move toward more sophisticated understanding over time. Students' estimated ability parameters obtained from item response theory analysis were used to compare the achievement between the coherent and traditional curriculum groups. Hierarchical linear model analysis was employed to examine students' learning growth rates between different curriculum materials by grade and school. The results revealed that there are differences in the trends of learning between the coherent and traditional group by grade and school performance level. The coherent curriculum shows a promising effect on student learning, particularly in high- and middle-performing schools. However, there are limits to using coherent curriculum on a low-performing school. This study concluded with a discussion of challenges and promises for using coherent curriculum materials to support student learning. in another study Using a paper-based media, Harp and Mayer (1997) discovered a similar pattern of results. A 550-word, six-paragraph passage with six captioned illustrations was assigned to certain students. The captioned pictures depicted the main processes in the cause-and-effect sequence that leads to lightning generation (with captions that repeated the key events from the passage). Each graphic was positioned to the left of the relevant paragraph. Other students read the same illustrated piece, which included six color illustrations to add interest to the presentation. Each image was labeled and placed to the right of the paragraph it was associated with. For example, next to the paragraph about warm moist air rising, there was a color photo of an airplane being struck by lightning, along with the text: "Metal airplanes transmit lightning exceptionally effectively, yet they sustain minimal harm since the bolt meets no resistance and flows right through." A photo of a burned uniform from a football player struck by lightning was presented in another section of the lesson. Students who received the lightning passage without color photographs did better on retention and transfer exams than students who received the lightning passage with color photos, generating roughly 52 percent more solutions on the transfer test, resulting in an effect size

of larger than 1. From the findings of these studies, it can be opined that coherence design principles can be applicable in a classroom situation. However, studies has proven its applicability in a higher institution, this study tends to prove its applicability in a secondary school scenario and its effect on students' academic interest and performance.

### **Statement of problem**

Computer studies as a subject or discipline lays a foundational knowledge prerequisite for every 21<sup>st</sup> century citizens and learners. The subject tries to imbibe into its learners the use of all systems applications in rendering solutions to human needs. It is the level of importance and need of the knowledge of this subject /discipline that necessitated the interest of the researcher in investigating the appropriate design principles that can best simplify the teaching and learning of computer studies while enhancing students' performance. Hence the question is *“can coherence design principles propounded by Mayer simplify the complex nature of teaching and learning computer studies, enhance students' interest and performance by promoting meaningful learning”?*

### **Aim and Objective**

The aim of the study is to examine the impact of coherence design principles on the interest and performance of students in computer studies, Specifically the study sought to;

1. ascertain the effect of coherence design principle in comparison to conventional text-based presentation on the interest of students in Computer Studies.
2. ascertain the effect of coherence design principle in comparison to conventional text-based presentation on the students' mean performance scores in Computer Studies.

### **Research question**

1. What is the effect of coherence design principle in comparison to the text-based presentation on the interest of students in Computer Studies?
2. What is the effect of coherence design principle in comparison to the text-based presentation on the students' mean performance scores in Computer Studies?

### **Hypotheses**

1. There is no significant difference between the interest of students taught Computer Studies using coherence design principles and those taught using the text based instructional presentation.
2. There is no significant difference between the mean performance scores of students taught Computer Studies using the coherence design principle and those taught using text based instructional presentation.

### **Methodology**

The study was carried out in selected private secondary schools in Obio-Akpor local Government Area in Rivers State, Nigeria. Coherence design principle is the independent variable, while academic performance and interest are the dependent variables The 2-group pre-test post-test quasi experimental design was adopted for the study One private secondary school was used as a control group, while the other was used as an experimental group. A performance test titled “computer students' Performance Test (CSPT)” was used to collect data on the student's performance. The instrument was validated by two subject matter experts and experts in measurement and evaluation.

The reliability of the CSPT was tested using Kuder Richardson (21) and a co-efficient of 0.80 was obtained. Coherence design principles as postulated by Mayer was used to design an instructional slide that was used in the teaching and learning of computer studies to Senior secondary school one students covering a topic titled “input and output system”. Input and output system is a content coverage area for all senior secondary school one students in their scheme of work and syllabus. The topic input and output system provide students with basic introduction to a computer system.

### Procedure

PowerPoint slides designed using the Coherence design principle was used to teach the experimental group, while text-based slides was used to teach the control group. Before the teaching and learning scenario, a pre-test was administered to the students. After the experiment, a performance test followed by a semantic interest scale questionnaire that was administered. These test and questionnaire were used to determine the effect of the various principles on the academic performance and interest of students in computer studies.

### Results

**Research Question One:** what is the effect of coherence design principle in comparison to conventional text-based presentation on the interest of students in Computer Studies?

**Table 1: Distribution and response of interest amongst students using coherence design principles**

S/N	Questionnaire items	Text-based	Coherence design
Q1	I enjoyed the presentation format of computer studies during teaching and learning	2.4	3.28
Q2	When thinking about computer studies, how will you rate the teaching presentation	2.4	3.14
Q3	I would love to attend the next computer studies classes	2.2	3.92
Q4	During teaching presentation, I lost interest	3.1	1.7
Q5	If you could change just one subject, would you change computer studies?	3.0	1.74
Q6	Computer studies classes always appears too long	3.0	2.06
Q7	How would you rate computer studies classes	2.4	3.12
Q8	During computer studies classes, I find myself sleepy	2.7	2.32
Q9	How satisfied were you during the computer studies classes?	2.4	3.7
Q10	Missing computer studies classes is like a treasure thrown into an ocean	2.4	3.66

*Criterion mean <2.5*

**Research Question two:** What is the effect of coherence design principle in comparison to conventional text-based presentation on the students' mean performance scores in Computer Studies?

**Table 2 mean and standard deviation of computer studies score by teaching methods**

Design	Pre-test $\bar{x}$ (SD)	Post-test $\bar{x}$ (SD)
Coherence Design	7.17(1.6)	17.65(1.6)
Text Based Design	7.26 (1.7)	14.34 (1.9)

$\bar{x}$ : mean; SD: Standard deviation

Table 2 displayed the mean and standard deviation of computer studies students taught using coherence design principles and text-based design. The table further revealed that students taught computer studies using coherence design principles has a higher post-test mean score of 17.65 when compared to the mean score of students taught computer studies using text-based design which had a mean score of 14.34. This shows a slight difference in favour of the coherence design principles.

**Hypothesis One:** There is no significant difference between the interest of students taught Computer Studies using coherence design principles and those taught using text based instructional presentation.

**Table 3 Test of hypothesis 1**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4.529	2	2.264	0.258	0.773	0.003
Intercept	4215.092	1	4215.092	479.582	0	0.709
Principle	4.495	1	4.495	0.511	0.475	0.003
Interest	0.029	1	0.029	0.003	<b>0.955</b>	0
Error	1731.451	197	8.789			
Total	43728	200				
Corrected Total	1735.98	199				

Table 3: displayed the output result of the test of Hypothesis 3 which states that the difference between the interest of students taught Computer Studies using coherence design principles and those taught using text based instructional presentation is not significant. Hence the null hypothesis: “: The difference between the interest of students taught Computer Studies using coherence design principles and those taught using text based instructional presentation do not differ significantly”. Was accepted

**Hypothesis two:** There is no significant difference between the mean performance of students taught Computer Studies using coherence design principle and those taught using text based instructional presentation.

**Table 4: Test of Hypothesis 2**

<b>Dependent Variable: Post Test</b>							
<b>Source</b>	<b>Type III Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>	<b>Partial Eta Squared</b>	
Corrected Model	4.529	2	2.264	0.258	0.773	0.003	
Intercept	4503.89	1	4503.89	512.441	0	0.722	
Performance	0.029	1	0.029	0.003	<b>0.005</b>	0	
Principle	4.495	1	4.495	0.511	0.475	0.003	
Error	1731.451	197	8.789				
Total	43728	200					
Corrected Total	1735.98	199					

Reject Ho

Table 2: displayed the output result of the test of Hypothesis 4 which states that “No significant difference exists between the mean performance of students taught Computer Studies using coherence design principle and those taught using text based instructional presentation”. findings revealed that there is no statistical difference. Hence, the null hypothesis “No significant difference exists between the mean performance of students taught Computer Studies using coherence design principle and those taught using text based instructional presentation.” was Rejected

### **Conclusion**

The finding of the current study indicates that Richard E Mayers multimedia design principle on coherence when compared to text-based can significantly enhance students’ interest in the taught subject.

### **Recommendation**

Based on the findings of the study, the Richard E Mayers multimedia principles should be adopted at all stages and levels of education when designing instructional slides. Instructional system designers and curriculum experts should also create awareness on these principles to various educational cadres. Workshops and conferences to encourage the use of instructional slides when appropriate and adopting the principles should be inculcated at the secondary school level by the bodies concerned with retraining of secondary school teachers.

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