E-Learning: Instructional Scaffolding tool in Teaching

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Abstract— Extracting information is now easier and more efficient. Thanks to our rapidly changing and progressing development of technology and its simplicity to share information can be the basis that students can use to learn and absorb the lessons with just a few clicks and taps of buttons and code. And with this, changing our ways of learning can be proven beneficial judging from all the research provided before about visual learnings expanding to a wide variety of students in simple preference, cognitive function and convenience to students. Non-linear text refers to the visual learning representation used to assist the learners. It may include graphs, pictures, and tables. Since the comprehension of knowledge and education could be difficult for some, we hope to alleviate the problem of students having various difficulties in class relating to their preferred learning style through our study. This study measures the effectiveness of non-linear text in the learning performance of the students and draws upon the model of non-linear text and linear text, and four other variables such as reading span, text memory, learning material, and comprehension. As students ourselves, we know that there are different learning styles and methods that are efficient for some but lacking for others. One of these learning styles is seeing data visually and comprehending them, showcasing our data obtained from surveys conducted on other students. For this purpose, the data were collected from the Grade 10 students of Panitan National High School. This study utilized Quasi-Experimental method with the support of SPSS. Inferring from the data gathered from the surveys conducted, we found that there are students that preferred learning visually using images and graphs. Furthermore, cognitive development and familiarization was noticeable and encouraged with the help of linear information and visual aids. In conclusion, the results revealed that the learning performance in the post-test of experimental group, interpreted as effective; while in the control group, it is moderately effective. It means, the experimental group showed much better performance compared to the control group. This simply means that the non-linear method of teaching is effective as a method of teaching and the students are able to learn more effectively and find specific information more quickly and efficiently through pictures, flowcharts, and graphs or non-linear text rather than the traditional way of teaching.

Index Terms— Linear text, Non-linear text, Instructional Scaffolding, E-learning, New technology in teaching, Teaching method, Quasi-experimental research

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1 INTRODUCTION

EDUCATION is the foundation on which a country is built, it is a method to obtain skills and knowledge. We can perceive that education is continuously changing and adapting to meet the needs of students. As student's interest geared towards new technologies, education must adapt to match those learning habits.

Education is a very important tool that we need in our daily life. It enables people and gets them prepared to con-front the challenges of life effectively. It enhances the individual growth of a person. Effective education is essential and is a pillar in how a country and its citizens prosper, it is used to obtain skills for either your career, day to day life and knowledge to build new ideas. Through education, our children will attain their full potential, as productive parts of society and as responsible and well-mannered citizens for the next generations. Not only this, but it also helps in improving the self-confidence of an individual and makes them certain of things in life.

Education may be a social institution through which a society's children are instructed fundamental scholastic information, learning skills, and social standards. And as the world changes constantly and we adapt in every corner of our life, it is also observed that the ways in education have changed from the students' view of learning and the teacher's perspective of teaching. We can now also conclude that education has always been changing and kept on evolving. An example of this is the use of Non-linear education, a kind of scaffolding tool which has also become one of the most rapidly growing market when it comes to new technology in teaching.

Non-linear text introduces a new method of learning that contrasts the linear text. Linear text forms a sequence like reading a novel or text from the beginning up to the end that is required to be done. Meanwhile, non-linear text is a type of learning tool that includes graphs, visuals, and presentations and usually the ideas stated in here are the main point or the specific information what you needed. So unlike a linear text, it does not require reading from the beginning to the end. Non-linear text is a visual scaffolding tool used to show the relationship between two or more sets of measurements. It uses visuals to assist the reader to capture the meaning of a video or image.

Currently, in our society, we can perceive that our world has become modernized and one of the things that have changed is the way we live and the way we learn. However, students not listening in class is becoming more and more concerning as the years go by. Also, as we observed, most of the students tend to study or learn just by themselves due to the dullness of their lessons. Not only this but we had also discovered that most of them wanted to explore more things and learn in their own ways.

For this reason, We hope to alleviate this issue by introducing a new teaching method that will finally usher in developments that may help encourage the whole of class to be motivated enough to learn and familiarize themselves with the lessons. Furthermore, our study hopes to boost the cognitive and memorization skills of visual learners through our research while acting as supplemental aids to those who are better learners in other fields. Our objectives are to investigate if students prefer

learning visually, prefer visual aids as a supplement and support and find out if visual aids have the potential to be used as a learning tool for schools worldwide. We hope to instigate this study as a survey for various different schools and to use existing researcher knowledge to recognize our findings in a way to benefit students and future researchers.

Generally, this study aims to measure the effectiveness of the non-linear text as an instructional scaffolding tool in teaching. Furthermore, the goal of this study is to identify how this new method can help in our current educational system and how it affects the students' cognitive and memorization skills. Indeed, the world is constantly changing and by improving our instructional scaffolding, we can catch up to the world's evolution.

2 METHODS

A case study has been designed to measure the effectiveness of linear and non-linear teaching methods. To assess the effectiveness of non-linear text as a new teaching method, the study was done through quasi-experimental research. The sample is purposive, for it serves the objectives of the study to find out the effectiveness of the non-linear text as a teaching and learning tool. It was carried out to investigate the feasibility of non-linear text as a scaffold in teaching and learning. The researchers used a researcher-made questionnaire to gather the needed data. The data needed for the study gathered using a 60 item questionnaire constructed by the researchers, which was divided into 5 parts: part (1) demographic profile, part (2) students' text memory in reading linear text, part (3) students' reading span in linear text, part (4) students' comprehension in reading non-linear text, and part (5) the instructional materials used in learning non-linear text. The questionnaire has undergone pilot testing and content validation. It was submitted to the panel for preliminary validation where comments and suggestions were given. The sampling method that was used in this study is the Stratified Random Sampling. Stratified Random Sampling is a type of probability sampling that allows researchers to improve precision relative to simple random sampling (SRS). The population was divided into non-overlapping groups, or strata, along a relevant dimension such as gender, ethnicity, political affiliation, and so on. The researcher then collected a random sample of population members from within each stratum. Through pilot testing, we, the researchers, were able to test the clarity and feasibility of our questionnaire before moving directly to our main study. The pilot testing was carried out at Inzo National High School, where the respondents were Grade 10 students from three (3) different sections, Rizal, Bonifacio, and Roxas. To determine the sample size of our respondents, we used stratified random sampling. With a total of 42 participants, 15 of them came from Rizal, 14 from Roxas and 13 from Bonifacio. Based on how these participants responded, the research approach was assessed, strengthened and then evaluated. After the pilot testing, the questionnaire was verified to be highly reliable with a result of 0.918. The final study was conducted at Panitan National High School. This study utilized two groups of respondents. This study was a population study of grade 10 students of Panitan National High School. To establish the effect of non-linear text in the performance of the Grade 10 High School students in Araling Panlipunan class, the researchers executed the following steps: Initially, two sections in Grade 10 (Sections: Magsaysay and Quezon) were identified as the respondents of this study. Necessary permission was secured from the office of the Principal. After the permit was granted, the researchers asked another A.P (Araling Panlipunan) teacher to conduct the study to avoid biases. The researchers conducted a pre-test and post-test to the selected Grade 10 students of Panitan National High School. This study was conducted for only a week from February 10, 2020, to February 17, 2020. Group I have undergone the experimental treatment using the Non-linear method, and Group II underwent the control treatment using the Traditional Technique (Lecture Method). Both groups were given tests (pre and post) on researcher-made tests before and after teaching, using the two approaches. The researchers employed three phases in conducting the study: the pre-experimental stage, the experimental stage, and the post-experimental stage. In the pre-experimental stage, the first step was the identification of the research lesson (topic). The researchers identified the topics covered during the fourth grading. After the identification of the lessons, the researcher apportioned these topics within the experimental period. Second, the researcher constructed a table of specifications considering the topics included in the fourth grading period. Third, the teacher administered the pre-test to the two groups of Grade ten students in Panitan National High school. When the pre-test was completely answered, it was checked, recorded and tabulated for analysis using the appropriate statistical tools. However, the test materials were kept in safe storage since the same test was administered at the end of the experiment. After the experimental stage, the test question in the pre-test was rearranged in preparation for the conduct of the post-test. The researchers conducted a post-test for all participants in the control and experimental group. The result was checked, recorded, tabulated and analyzed using the appropriate statistical tools. The data on the pre-test and post-test were tallied and encoded in the Microsoft Excel application. Both the pretest and post-test results were processed using the Statistical Package for Social Science (SPSS) software. The difference between pre-test and post-test results were determined by submitting the data to statistical analysis using inferential statistical tools to answer the statement of the problem and the hypothesis stated in the study. Both tabular and textual presentations were used in data presentation and analysis.

3 RESULT, ANALYSIS AND DISCUSSION

3.1 Learning Performance in the Pre-test and Post-test of the Experimental and Control Group

As Table 1 presents the learning performance in the Pre-test and post-test of the experimental group design using the non- linear text teaching method in the experimental group and the linear text learning method in the control group.

The Pre-test performance in the 50-item test of the experimental group of 16.63 (SD=3.432) was slightly higher compared to the pretest performance of the control group with only 14.68 (SD=3.778). Performances of both groups were verbally interpreted as "less effective." This implies that the non-linear instruction failed to meet expectations and progress towards performance was not met.

Great improvements were observed in the posttests of both the experimental (M=35.95, SD=3.863), interpreted as "effective" and control groups (M=26.80, SD=7.201), interpreted as "moderately effective." However, the experimental group showed a much better performance. This tentatively shows effectiveness of the intervention.

Table 1. Mean and Standard Deviation of the Learning Performance in the Pre-test and Post-test of the Control and Experimental Group Design

Learning Performance of the Control and Experimental Groups

Group	Test	Mean	SD	Verbal Interpretation
Experimental	Pre-test	16.63	3.432	Less Effective
	Post-test	35.95	3.863	Effective
Control	Pre-test	14.68	3.778	Less Effective
	Post-test	26.80	7.201	Moderately Effective

Score Interval	Verbal Interpretation
41-50	Very Effective
31-40	Effective
21-30	Moderately Effective
11-20	Less Effective
0-10	Least Effective

This result conforms to the finding of Shabiralyani et. al.(2015). Their study found out that with the help of visual aids and non-linear presentation, the learning of students increases as it involves more thinking for them and for the teacher to have lessen gap with their students when communicating with them.

The result above is further supported by the result of the study of Noor (2017). In his study he found out that non-linear text method of learning are able to disseminate information efficiently and effectively.

3.2 Difference in the Pre-test Score of the Experimental and Control Group

Table 2 presents the difference of the pre-test score of the experimental group and the pre-test score of the control group.

There was a slight difference of 1.950 in the pretest performance of students in favor of the experimental group. However, such difference was significant, $t(78)=2.416$, $p<.05$. This means that the experimental group performed better in the pretest compared to the control group.

Thus, the hypothesis stating that "there is no significant difference in the pre-test score of the experimental and control group" is rejected.

Table 2. Mean of the Pre-test score of the Control and Experimental Group Design

Pre-test Score of the Experimental and Control Group

Groups	Mean	Mean Diff.	t-ratio	df	p-value	Probability
Experimental	16.63	1.950	2.416	78	.018	s
Control	14.68					

This result conforms to the study of Maleki et.al (2012). This study involves medical students who were observed with the methods of teaching the non-linear and linear texts and as a result of their pre-test, it showed that the experimental group got a higher score compared to the control group.

3.3 Difference in the Post-test Score of the Experimental and Control Group

Table 3 presents the difference in the Post-test Score of the Experimental and Control Group

A big mean difference of 9.150 in the post-test performance in favor of the experimental group translated to a significant difference, $t (78) =7.082$, $p<.05$. This clearly implies that the experimental group performed better in the posttest compared to the control group.

Therefore, the hypothesis stating that "there is no significant difference in the post-test score of the experimental and control group" is rejected.

Table 3. The difference in the Post-test Score of the Experimental and Control Group

Post-test Score of the Experimental and Control Group

Groups	Mean	Mean Diff.	t-ratio	df	p-value	Probability
Experimental	35.95	9.150	7.082	78	.000	s
Control	26.80					

3.4 Relationship between the Pre-test and Post-test of both the Experimental and Control Group

Table 4 presents the relationship between the Pre-test and Post-test of both the Experimental and Control Group

Strong positive correlations were manifested between pre-test and post-test of both experimental and control groups. These correlations were significant for both experimental (r (40) =.401, p<.05) and control (r (40) =.439, p<.05) groups. These imply that the pre-tests had great influence on the results of the post-tests.

Table 4. The relationship between the Pre-test and Post-test

of both the Experimental and Control Group

	Correlation	Degree of Relationship	p-value	Probability
Experimental Group (Pre-test-Post-test)	.401	Strong positive correlation	.005	s
Control (Pre-test-Post-test)	.439	Strong positive correlation	.010	s

This result conforms to the study of Macwan (2015). His study confirmed that there is a strong positive correlation between the pre-test and post-test of both the experimental and control group. In his study, he found out that after using visual aids with graphic presentation, the result of the post-test of the respondent improved greatly to a high degree. He further evened that learning becomes enjoyable if visual aids such as images and graphs are utilized.

3.5 Difference in the Level of Performance in the Pre-test and Post-test of the Grade 10 Students when Grouped according to Gender in the Experimental and Control Group

Table 5 presents the difference in the Level of Performance in the Pre-test and Post-test of the Grade 10 Students when Grouped according to Gender in the Experimental and Control Group

Pre-test and post-test performances of students varied between gender for both experimental and control groups.

In the experimental group, there was clear dominance of male students in both the pre-test and the post-test. However, these differences were not significant for both pre-test (t (38) =.334, p>.05) and post-test (t (38) =1.988, p>.05). This means that regardless of gender students had the same performance in both the pre-test and post-test.

In the control group, a different trend was evident where dominance was in favor of the females for both pretest and post-test. However, significant difference was only in the pre-test (t (38) =3.367, p<.05) and not in the post-test (t (38) =.133, p>.05). This implies that females performed statistically better than males in the pre-test while regardless of gender students performed the same in the post-test.

Therefore, the hypothesis stating that there is no significant difference in the level of performance in the pre-test and post-test of the Grade 10 students when grouped according to gender in the experimental and control group is accepted in the pre-test and post-test of the experimental group and the post-test of the control group. It was only in the pre-test of the control group that same hypothesis is rejected.

Table 5. The difference in the Level of Performance in the Pre-test and Post-test of the Grade 10 Students when Grouped according to Gender in the Experimental and Control Group

Group	Test	Gender	Mean	Mean Diff.	t-ratio	df	p-value	Probability
Experimental	Pre-test	Male	16.78	.371	.334	38	.740	ns
		Female	16.41					
	Post-test	Male	36.96	2.368	1.988	38	.054	ns
		Female	34.59					
Control	Pre-test	Male	13.83	3.367	2.617	38	.013	s
		Female	17.20					
	Post-test	Male	26.77	.133	.050	38	.960	ns
		Female	26.90					

The results above conform to the study of Mayer (2011). In his study, he found out that gender has nothing to do with the pre-test and post-test results of the respondents in the experimental group. He further averred that the answers of the respondents do not vary significantly. It means they have the same test result in the pre-test and post-test regarding of their gender.

The study of Shiota (2011) also supports the findings above. In his study, he found out that in the control group, the pre-test result has a significant difference. It means that the answer of the respondents vary significantly in terms of gender. Both male and female have different results. While in the post-test result of the linear method, both male and female almost had the same answers.

As shown in the Table 6 below, there was a higher appreciation by the respondents of the linear text (M=4.02, SD=.409) compared to non-linear text (M=3.90, SD=.491), although both were of the same level of "high". This simply means that linear text is better preferred by respondents over non-linear text. Although in the survey the data revealed that the respondent's preferred linear text, in the actual test result it turns out in the experimental group which uses non- linear method of instruction got the higher score.

Table 6

	Mean	Std. Deviation	Verbal interpretation
Linear Text	**4.02**	**.409**	**High**
Non-Linear Text	**3.90**	**.491**	**High**

A closer look of the linear text Table 7 revealed an almost equal appreciation by the respondents on memory (M=4.02, SD=.452) and reading span (M=4.03, SD=.445), both verbally interpreted as "high." This suggests that memory and reading span are of almost the same footing in the area linear text.

Table 7

	Mean	Std. Deviation	Verbal interpretation
Linear Text (Memory)	4.02	.452	High
Linear Text (Reading Span)	4.03	.445	High
Linear Text	**4.02**	**.409**	**High**

Further scrutiny of the data showed that of the 15 statements on "memory", only four were rated as "very high" while the rest were "high" justifying the rating on "memory" as "high." Top statement on "memory" was "If I have enough knowledge about the topic, I would still prefer reading to know more about the topic" with a mean of 4.34. This was followed downwards by "I feel that information would be easier to absorb when reading." (M=4.26). At the bottom of the list was "I am using the Skimming method in the text to get the main idea." (M=3.66) followed upwards by "Reading text is easy to memorize." (M=3.71).

In the case of reading span, the over-all rating of "high" was attributed to six of the 15 statements which were rated as "very high" and 8 as "high." The top rating of 4.36 was on "I start reading from the first paragraph and read all the way through the last paragraph." This was closely followed downwards by "If the content is interesting, I keep reading even though the text is difficult" with a mean of 4.35. Having the least mean with only 3.25 ("moderately high") was "I can finish reading a whole book in a short period of time." This was followed upwards by "I am unable to maintain my focus when I read a long set of text" (3.65).

Table 8

Reading Span	Mean	Verbal Interpretation
I start reading from the first paragraph and read all the way through the last paragraph.	4.36	Very High
If the content is interesting, I keep reading even though the text is difficult.	4.35	Very High
If the content is interesting, I keep reading even though the text is difficult.	4.30	Very High
I repeatedly read a certain sentence for several times until I understand it.	4.29	Very High
If I don't understand something such as a word and phrase, I continue reading it for several times until I understand the information.	4.29	Very High
I prefer reviewing my notes read it for several times until I comprehend it.	4.24	Very High
I continue reading even if I have the difficulty in understanding it, consulting a dictionary or making some illustrations of some difficult words until I understand it.	4.18	High
I love to read more phrases and conceptualize their meaning.	4.11	High
I change my reading speed depending on the difficulty of a text.	4.05	High
I like to read challenging texts over and over again and it makes me understand the text more.	4.00	High
I always try to finish my reading on time.	3.90	High
I often read novels with large amounts of text.	3.79	High
I love to read newspapers and articles over and over again. It is simply awesome.	3.66	High
I am unable to maintain my focus when I read a long set of text.	3.65	High
I can finish reading a whole book in a short period of time.	3.25	Moderately High
Mean	**4.03**	**High**

For non-linear text Table 9, although both were of the same level as "high", instructional material registered a higher mean of 3.94 (SD=.509) compared to comprehension with a mean of only 3.86 (SD=.539). This result conforms with the observation today that comprehension is becoming a challenge to students as serious reading has been neglected in exchange for the more time spent on gadgets, games and social media.

Table 9

	Mean	Std. Deviation	Verbal Interpretation
Non-Linear Text (Comprehension)	3.86	.539	High
Non-Linear Text (Instructional Material)	3.94	.509	High
Non-Linear Text	**3.90**	**.491**	**High**

In-depth analysis of the data revealed that all statements except one had ratings of "high" only. The lone statement with managed a "very high" rating of 4.29 was on "I can feel that I can develop more skills when I am given ample time to comprehend what I have read as instructions and steps." This was followed downwards by "I Pay attention to the graphs, pictures or other visuals presented with the text" with 4.16. At the bottom with 3.55 ("high") was "While reading, I draw sketches related to the text or what I read" followed upwards by "Non- linear text is easier to master compared to other styles of learning" with 3.69 ("high").

Table 10

Comprehension	Mean	Verbal Interpretation
I can feel that I can develop more skills when I am given ample time to comprehend what I have read as instructions and steps.	4.29	Very High
I Pay attention to the graphs, pictures or other visuals presented with the text.	4.16	High
Understanding through pictures and representations is easier to remember long term and is harder to forget.	4.06	High
While reading, I prefer if it is presented in graphs.	3.90	High
I pay attention to indirectly stated ideas and try to make inferences about them.	3.88	High
I understand more if the presentation is in graphs and flowchart form.	3.88	High
I would able be to understand the lesson easily specially when it comes to graphs and pie charts.	3.85	High
I try to express the ideas in the text with flowcharts or illustration.	3.81	High
While reading, I try to make some illustrations to have better inferences.	3.79	High
Even the most complex of topics are easier to understand when I make flowcharts about them.	3.79	High
I translate the text into graphic presentation to help me comprehend better.	3.78	High
More graphs are presented the better my learning is.	3.76	High
The amount of what I comprehend correlates to me being able to find the main idea especially when it comes to graphs.	3.76	High
Non- linear text is easier to master compared to other styles of learning	3.69	High
While reading, I draw sketches related to the text or what I read.	3.55	High
Mean	**3.86**	**High**

Just like comprehension, instructional material also managed to have all statements except one ratings of "high" only. Enjoying a big lead over the next statement was "Instructional material makes my learning faster" with 4.30 ("very high"). Following downwards was the statement "I feel that I will understand the lessons better if every textbook has pictures" with 4.16 ("high"). Tied at 3.72 (high) and situated at the bottom of the list were "I am bored when teachers do not use instructional materials such as pie graphs and visuals" and "I prefer reviewing power point presentations rather than looking at the textbooks".

Instructional Material	Mean	Verbal Interpretation
Instructional material makes my learning faster.	4.30	Very High
I feel that I will understand the lessons better if every textbook has pictures.	4.16	High
I feel that pictures can help me amplify to improve my performance.	4.10	High
It always gets my attention when teachers often use instructional materials such as bar graphs and flow charts.	4.03	High
I pay attention to visuals such as graphs, pictures, or tables.	3.96	High
Having instructional materials enhance my visual memory.	3.95	High
I would be more comfortable looking at graphs and images instead of paragraphs to learn.	3.91	High
It would be more interesting if the lesson is presented in graphic forms.	3.91	High
The materials used by the teacher has a crucial part in my understanding especially if it is shown in graphic form.	3.90	High
More graphs are presented the better my learning is.	3.90	High
Imagery prevents boredom and poor participation in the class.	3.89	High
It would be more interesting if there's a non-linear presentation while learning.	3.86	High
I prefer to use pictures to learn easily than reading books.	3.84	High

4 CONCLUSION

1. The learning performance in the pre-test of the experimental group was slightly higher compared to the learning performance in the pre-test of the control- group. However, the performance of both groups was verbally interpreted as less effective. Furthermore, great improvements were observed in the post-test of both experimental groups, interpreted as effective; while in the control group, it is moderately effective. It means, the experimental group showed much better performance compared to the control group. This simply means that the non- linear method of teaching is effective as a method of teaching and the students can learn more effectively and find specific information more quickly and efficiently through pictures, flowcharts, and graphs or non-linear text rather than the traditional way of teaching.

2. There was a slight difference in the pre-test performance of students in the control and experimental group. The result favors the experimental group. It specifies that the traditional way of learning is still effective, but it is also applicable to adapt a new method of learning, which is the non-linear teaching method.

3. There was a big mean difference in the post-test performance of the experimental and control group. The experimental group performed better in the post-test result compared to the control group. It confirms that students choose to learn lessons visually or with the help of graphs and presentation, this also connects to the modernization that the students and the educational system have adapted. The performance of the control group also indicates that the traditional way is already on beyond on time and slowly been surpassed by the more evolutional style of education. This clearly shows that the use of non- linear method of teaching is effective.

4. There was a strong positive correlation between the pre-test and the post-test result of both experimental and control groups. It means the post-test results are mutually dependent on their pre-test result.

5. The result of the pre-test and post-test performance of students varied between gender for both experimental and control groups. In the experimental group, there was a clear dominance of male students in both pre-test and post-test. However, their difference was not significant for both pre-test and post-test. It means, regardless of gender, students had the same performance in both the pre-test and post-test. In the control group, a different trend was evident where the dominance was in favor of females for both pre-test and post-test. However, the significant difference was only in the pre-test. This means females performed statistically better than males in the pre-test whether regardless of gender, students performed the same in the post-test.

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