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Exploring The Effect Of Concept Mapping Model On Pre-Service Teachers' Preparation In Universities In North East, Nigeria

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ABSTRACT
The purpose of this study was to investigate the effect of concept mapping on pre-service teachers' preparation in North East Nigeria's public Universities. Participants were 72 part 3 students from the two universities sampled. One of the classes was randomly chosen as experimental group (30), taught educational technology and the other was control (42) group that did not receive any presentation on concept mapping. Data were collected via the pre-and post-test of the Educational Technology Achievement Test (ETAT) and Concept Maps Attitude Scale (CMAS). The study conducted in six weeks in a class that has two contact hours a week. Results showed that while there were no significant differences in the attitude and achievement between the experimental and control groups. However, the experimental group students were observed to have a tendency of more positive attitude than the control group students. Results also showed that drawing concept map instruction was more effective than traditional instruction in improving achievement of the participating students.
Keywords: Concept mapping, Competency, Pre-Service Teachers

INTRODUCTION
A concept map is a graphic organizer or schematic diagram or semantic network that includes concepts arranged in a hierarchical order linked by words that form propositions (Novak, 2002*)*. Concept maps can be made by teachers or students either individually or in a group. They are used in a variety of situations, such as in an overview at the beginning of a unit, during instruction to assess conceptual understanding, and at the end of a unit to review for a test or to evaluate learning.

Graphic organizers provide a visual, holistic representation of facts and concepts and their relationships within an organized frame. They have proven to be effective tools to aid learning and thinking by helping students and teachers to represent abstract information in more concrete form, depict relationships among facts and concepts, relate new information to prior knowledge, and organize thoughts for writing. Graphic organizers exist in a variety of forms such as the concept map, sequence chain, mind map, T-chart, flowchart, matrix, venn diagram etc

Interactive whiteboard is a touch-sensitive screen that works in conjunction with a computer and a projector. The first interactive whiteboard was manufactured by SMART Technologies Inc. in 1991.Educators were the first people to recognize the interactive whiteboard's potential as a tool for collaboration, improving student learning outcomes and streamlining lesson planning. Educators continue to comprise the largest user base for this technology, particularly in the United States and the United Kingdom.

How can an interactive whiteboard be used in a learning environment? Interactive whiteboards are an effective way to interact with digital content and multimedia in a multi-person learning environment. Learning activities with an interactive whiteboard may include, but are not limited to the following: Manipulating text and images , Making notes in digital ink, Saving notes for later review by using e-mail, the Web or print, Viewing websites as a group, Demonstrating or using software at the front of a room without being tied to a computer, Creating digital lesson activities with templates, images and multimedia, Writing notes over educational video clips, Using presentation tools that are included with the whiteboard software to enhance learning materials, Showcasing student presentations Connecting to Learn: Student Engagement Most people need to reinforce their beliefs and understandings by asking others questions, thereby making learning an inherently social activity. Current education theories are grounded in the notion of the social learner and position student engagement as a key component of knowledge construction. These learning theories are shown in the following chart.

A common thread between these three learning theories is the understanding that student engagement is crucial to learning and, as a growing collection of international research proves, interactive whiteboards promote student engagement. Educators can use digital resources while maintaining dynamic interaction with the entire class, provide computer-based learning without isolating students and encourage a higher level of student interaction in both teacher-directed and group-based exchanges.

Perhaps one of the biggest challenges of integrating ICT into learning environments is maintaining dynamic interaction with students as they focus on their individual computer screens. Interactive whiteboards promote interaction among the students, the learning materials and the teacher, and enrich ICT by providing a large work space for hands-on work with multimedia resources. Having a display surface large enough for everyone to see encourages a high level of student interaction. A teacher and a student can interact with the interactive whiteboard at the front of the class and the rest of the students remain involved.

Whole-class teaching brings the entire class together, focuses their attention and provides structured, teacher-focused group interaction. Constructivism relies on the learner to select and and transform information, build hypotheses in order to make decisions and ultimately construct meaning. Active learning learners actively engage in the learning process through reading, writing, discussion, analysis, synthesis and evaluation, rather than passively absorbing instruction (e.g., lecture model of instruction). Students, so they encourage greater focus, participation and interaction, and improve student learning outcomes as a result.

Observations from the United States Gerard and Widener (1999) find that “the Smart Board interactive whiteboard supports interaction and conversation in the classroom; it helps with the presentation of new cultural and linguistic elements.” Solvie (2001) investigated the correlation between the use of an interactive whiteboard as a delivery tool for literacy instruction in a first-grade classroom and student attention to and participation in the literacy lessons. Her research found: The Smart Board [interactive whiteboard] was novel and created enthusiasm for learning on the part of the students as evidenced in remarks made during the lessons presented using the Smart Board and during individual student interviews, such as “I like touching the Smart Board,” “my finger is magic,” “I like when the lines get different,” “it’s a lot more easy using the interactive whiteboard, but I don’t know why,” “we used the Smart Board and it went ding, ding, ding,” “every part of the word is special” and “the board is magic.” Students were engaged when they actually touched the Smart Board or manipulated text on it.

In 2001, Solvie focused her research on interactive whiteboards, and in an article originally published in The International Reading Association’s journal, The Reading Teacher, she reported, “It engaged my primary students in literacy learning. I was able to interact with the class, demonstrating, modeling and manipulating what was on the board by touch. I was not confined to, or focused on, a computer that separated me from the class. Visual display in the form of diagrams, webs and pictures, as well as use of colors and shapes to highlight text, prompted engagement.”

Additional U.S. research focusing on middle-school students and teachers, and their attitudes towards interactive whiteboards indicates a strong preference for the use of inter- active whiteboards in the classroom. As Beeland (2002) asks, "Does the use of an interactive whiteboard as an instructional tool affect student engagement? The unequivocal answer, based on the results of both the surveys and questionnaires, is yes. The results of the survey indicate that interactive whiteboards can be used in the classroom to increase student engagement during the learning process."

Observations from the United Kingdom Interactive whiteboard research is also being conducted in the UK, where Reed (2001) studied students' initial responses to use of an interactive whiteboard during classes:

The immediate advantage of this arrangement compared to seating students at individual workstations has been that websites can be examined as a group activity so that communication between members of the group continues, whether in English or in a foreign language. A further benefit is derived from the fact that several members of the group are not especially computer literate and are daunted by the prospect of seeking out and using websites on their own, particularly interactive sites which require regular responses from the. It allows members of the group to ask and hear others' questions and reactions before starting tasks individually.

Other UK researchers have also found correlations between interactive whiteboards and student–teacher engagement. Ball (2003) details the increased potential for teachers to concentrate on student responses during lessons where an interactive whiteboard is used, and Cunningham et al. (2003) point to the benefits of the fast-paced, engaging interactive-whiteboard classroom. Edwards and Fraser (2009) highlight the in-class opportunities that the flexibility of interactive whiteboards allows students and teachers, and Latham's (2002) teacher-focused research finds "two-thirds of the teachers felt that the white- board offered strategies for teachers to develop interactive teaching. One-third stated that pupils from all ability groups were now more willing to take part in lessons." In addition, Cox et al. (2003) have concluded that interactive whiteboards allow teachers to gain a deeper understanding of their students' needs, and students are better able to learn through collaboration with each other.

British Educational Communications and Technologies Association (Becta)-funded research from Bransford (2003) supports these claims in a research project focusing on the use of interactive whiteboards in primary schools. According to a primary school teacher participating in the project, student attention and focus on lessons is improved with the introduction of digital images and text on the interactive whiteboards. This teacher adds that students are "just glued the whole time and they do get a lot more from it."

Objectives of the Study

Specifically, the research is expected to achieve the following objectives:

1. To determine the Pre-service undergraduate student-teachers' concept mapping tools competencies in North-East Nigeria
2. To determine the concept mapping classroom competencies required by education student-teachers
3. To determine the comparative mean effect of using the concept mapping and the conventional method

Research Questions

1. What are the concept mapping tools competencies required by Pre-service undergraduate student-teachers in North-East Nigeria?
2. What are the concept mapping classroom competencies required by Education student-teachers in North-East Nigeria?
3. What is the comparative mean effect of using the concept mapping and the conventional method on education student-teachers in North-East Nigeria?

Hypotheses

H_{O1}: There is no significant difference in the mean response of Lecturers of Education Department and Information and Communication Technology unit's staff in Universities on the concept mapping tools competencies required by education student-teachers in North-East Nigeria

H_{O2}: There is no significant difference in the mean response of Lecturers of Education Department and Information and Communication Technology unit's staff in Universities on the concept mapping classroom competencies required by student-teachers in North-East Nigeria

H_{O3}: There is no significant difference in the mean of cognitive achievement of student-teachers taught educational technology with the concept maps and those taught without the concept maps.

Significance of the Study

The findings of this study would be beneficial to students, student-teachers, teachers, lecturers, Universities and all institutions that runs the teacher-education programmes, education agencies and Ministries of Education.

LITERATURE REVIEW

Novak has argued that new *knowledge creation* is nothing more than a relatively high level of meaningful learning accomplished by individuals who have a well organized knowledge structure in the particular area of knowledge, and also a strong emotional commitment to persist in finding new meanings (Novak, 1977, 1993, 1998). Epistemology is that branch of philosophy that deals with the nature of knowledge and new knowledge creation. There is an important relationship between the psychology of learning, as we understand it today, and the growing consensus among philosophers and epistemologists that new knowledge creation is a constructive process involving both our knowledge and our emotions or the drive to create new meanings and new ways to represent these meanings. Learners struggling to create good concept maps are themselves engaged in a creative process, and this can be challenging, especially to learners who have spent most of their life learning by rote. Rote learning contributes very little at best to our knowledge structures, and therefore cannot underlie creative thinking or novel problem solving.

RESEARCH METHODS

The population of the study was 223 which comprised of 176 lecturers and xx ICT unit staff in the 8 Universities in North East, Nigeria. There was no sampling; hence, the whole population was used for the study due to the manageable size of the population. The instrument used for data collection was a structured questionnaire adapted from Ibanga and Dawasa 2021. The responses on the questionnaire were structured on a 5-point Rating scale of Highly Required (HR) = 5, Required (R) = 4, Moderately Required (MR) = 3, Slightly Required (SR) = 2, and Not Required (NR) = 1. The questionnaire was having a reliability index of 0.82. Data for the study was collected by the researchers with the help of 8 research assistants. Mean statistic was used to answer the ***two*** research questions of the study while t-test was used to test the null hypotheses of the study. All items with mean score of 3.5 and above were considered "Required" and all items with less than 3.50 were considered "Not Required". In deciding for the hypothesis, were the p-value was greater than the α-value, the null hypothesis was considered "Significant" and if otherwise "Not Significant".

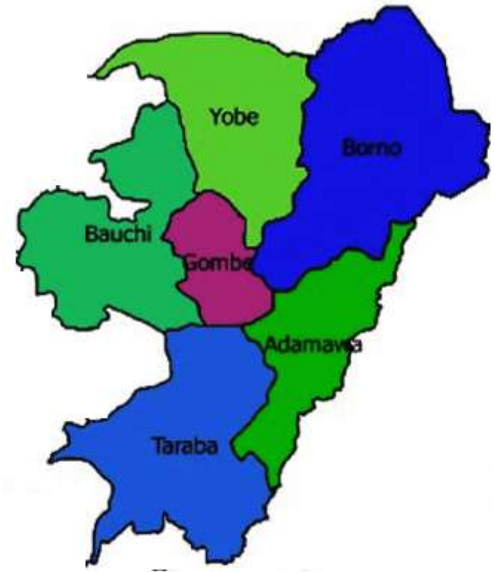
Design of the Study

The study adopted a multi-method research design involving Descriptive Survey research as well as Quasi-experimental research designs. According to Janice (2003), multi-method research is used when two or more research methods are employed in one study. Gall, Gall and Borg (2007) described descriptive survey as a method of investigation using questionnaire or interview to collect data from a sample that has been selected to represent a population to which the findings of the data analysis can be generalized.

On the other hand, according to Cohen, Manion and Morrisom (2007), quasi-experimental design is employed only when randomization was not possible and it is typically easier to set up than real experimental design. Similarly, to use a natural classroom setting for experimental research without random assignment, a nonequivalent control group design of Quasi-experimental is considered more appropriate (Sambo, 2005).

Area of the Study

The geographical area of the study is North East Nigeria which consists of six states namely: Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe States. The region lies between longitudes longitude 4.92˚ North of the equator and latitude 6.26˚ East on the equator. The region is bordered by Kano, Jigawa, Plateau and Benue states within Nigeria at the same time sharing international boundaries with republic of Cameroon, Chad and Niger. (North East Nigerian map and mapping data, 2016).



Nigeria Geographic Information System, North East Nigeria Map and Mapping Data (2016)

Population of the Study

The target population of the study is 243, comprising of students of 2020/21 academic session. The population was made up of part III pre-service teachers.

Sample and Sampling Technique

A purposive sampling was adopted for selecting the universities and a simple random sampling technique was used for selecting the students that partook in the study from the chosen set.

Reliability

The study adapted a standardized instrument from the study of Ibanga and Dawasa (2021), which has a reliability index of 0.82. According to Spiegel (1992), an instrument will be considered reliable if it lies between 0.6 and 1.0. This, therefore, confirms the reliability of the data collection instrument that was used.

RESULTS

Research Question One: *What are the concept mapping tools competencies required by Pre-service undergraduate student-teachers in North-East Nigeria?*

Table 1: Mean and Standard Deviation of Lecturers and ICT Unit Staff on the Concept mapping tools Competencies Required

		N_l =42	n_i= 34	n = 76		
S/NO	**ITEMS**	$\bar{x}_l$	$\bar{x}_i$	$\bar{x}_G$	σ	**Remark**
1.	Video conferencing	3.90	3.88	3.89	0.31	Required
2.	Online whiteboard for real-time collaboration	4.86	4.82	4.84	0.37	Required
3.	Instant massaging tool	3.62	3.59	3.61	0.59	Required
4.	Participation control tool	3.90	3.88	3.89	0.31	Required
5.	Breakout rooms tool	3.81	3.76	3.79	0.62	Required
6.	Screen sharing tool	3.79	3.76	3.78	0.42	Required
7.	File annotations tool	3.55	3.53	3.54	0.50	Required
8.	Video playback tool	4.07	4.06	4.07	0.41	Required
9.	Quizzing tool	3.79	3.76	3.78	0.58	Required
10.	Tools for movable partition walls	3.79	3.76	3.78	0.42	Required
	Group Mean			**3.90**		**Required**

$\bar{x}_l$= Mean of Lecturers, $\bar{x}_i$ = Mean of ICT Unit Staff, $\bar{x}_G$= Grand Mean, σ = Standard deviation n_l = Number of Lecturers, n_i = Number of ICT Experts, n =Total Number of Respondents

Table 1 shows the response on the concept mapping competencies required by Computer students-teachers. The respondents indicated that items 1 – 10 are concept mapping tools competencies required by Computer students-teachers with mean responses which range between 3.54 and 4.84and their corresponding standard deviation of which also ranges between 0.31 and 0.62 respectively. With the group mean of 3.90, the respondents showed that all the items listed in Table 1 are concept mapping competencies required by Computer students-teachers.

Research Question Two: *What are the concept mapping classroom competencies required by Education student-teachers in North-East Nigeria?*

Table 2: Mean and Standard Deviation of Lecturers and ICT Unit Staff on the Concept mapping Competencies Required

		N_l =42	n_i= 122	n = 164		
S/NO	**ITEMS**	$\bar{x}_l$	$\bar{x}_i$	$\bar{x}_G$	σ	**Remark**
11.	Ability to multitask in concept mapping environment	3.95	3.94	3.95	0.22	Required
12.	High level of the concept mapping technology mastery	3.79	3.76	3.78	1.49	Required
13.	Ability to create a comfortable learning environment to students using the virtual platform	3.81	3.76	3.79	0.62	Required
14.	Ability to build rapport with the students using the concept mapping platform	3.86	3.82	3.84	0.49	Required
15.	Mastery of the subject matter before using the concept mapping platform	4.24	4.21	4.22	1.55	Required
16.	Ability to communicate effectively with students	4.19	4.12	4.16	0.88	Required
17.	Effective time management	3.95	3.94	3.95	0.22	Required
18.	Ability to calm/reassure panicking students	3.86	3.82	3.84	0.37	Required
19.	Ability to evaluate students' performance form feedback	4.05	4.03	4.04	0.20	Required
20.	Ability to direct online discussion without distraction	3.90	3.88	3.89	0.45	Required
	Group Mean			**3.95**		**Required**

$\bar{x}_l$= Mean of Lecturers, $\bar{x}_i$ = Mean of ICT Unit Staff, $\bar{x}_G$= Grand Mean, σ = Standard deviation n_l = Number of Lecturers, n_i = Number of ICT Experts, n =Total Number of Respondents

Table 2 shows the response on the concept mapping competencies required by Pre-service undergraduate Computer students-teachers. The respondents indicated that items 11 – 20 are concept mapping competencies required by Computer students-teachers with mean responses which ranged between 3.78 and 4.22 and their corresponding standard deviation of which also ranges between 0.20 and 1.55 respectively. With the group mean of 3.95, the respondents showed that all the items listed in Table 1 are concept mapping competencies required by Computer students-teachers.

Research Question Three: *What is the comparative mean effect of using the concept mapping and the conventional method on education student-teachers in North-East Nigeria?*

Table 3: Mean of pretest and posttest scores of the student-teachers' Educational Technology Achievement Test (ETAT) and Concept Maps Attitude Scale *(CMAS)* Cognitive achievement between students taught Educational Technology using the concept map and those taught using the conventional method

Treatment group	N	Pretest mean	SD_1	Posttest mean	SD_2	Mean Gain	Sig
Web based Application	24	35.25	5.36	78.00	13.00	42.75	1.88
Standalone Application	25	43.68	4.20	79.20	7.10	36.12	.454

SD1 =Standard Deviation for the pretest SD2 = Standard Deviation for post-test

Table 3 shows that group that used the tutor in learning cognitive achievement either standalone or web-based application. Web-based had a pre-test mean score of 35.25 with Standard Deviation 5.36697 of 42.75 and the post-test mean score of 78.80 with Standard Deviation of 78.00 making pre-test post-test mean gain 42.75. The group used the tutor with their class teachers as a compliment to instructional delivery learning psychomotor skills the standalone application had a pre-test mean score of 43.680 and standard deviation of 4.20 and post-test 78.00 with a standard deviation of 13.01 of mean gain 42.72. Concept mapping application was effective in improving students cognitive achievement test on concept mapping application was higher in the group that used it. The F- calculated value at degree of freedom (1, 49) is 1.88 with a significance value of .454 which is above cut-off of .05 the null-hypothesis

Hypothesis One: There is no significant difference in the mean response of Lecturers and Information and Communication Technology unit's staff in Universities on the concept mapping tools competencies required by students-teachers.

Table 3: t-test Statistical Analysis of Difference between the Mean Responses of the Lecturers and ICT Unit Staff Concept Mapping Tools Competencies Required

Respondents	**N**	**Mean**	**Σ**	**Df**	**P – value**	**Remark**
Lecturers	42	3.91	0.19	74	0.575	Not Significant
ICT Unit Staff	34	3.88	0.19			

P >0.05 N= Number of respondents, σ = Standard Deviation

Table 3 is the result obtained when hypothesis one was tested at 0.05 level of significance. The p-value stood at 0.575. Since the p-value is greater than the α-value of 0.05, implies that there is no significant difference in the mean response of Computer students-teachers and Information and Communication Technology unit's staff in Colleges of Education on the concept mapping tools competencies required by Computer students-teachers. The null hypothesis, H_{O1}, is therefore upheld.

Hypothesis Two: There is no significant difference in the mean response of Lecturers and Information and Communication Technology unit's staff in Universities on the concept mapping competencies required by student-teachers.

Table 4: t-test Statistical Analysis of Difference between the Mean Responses of the Lecturers and ICT Unit Staff on Concept Mapping Tools Competencies Required

Respondents	N	Mean	σ	df	P – value	Remark
Lecturers	42	3.96	0.35	74	0.726	Not Significant
ICT Unit Staff	34	3.93	0.40			

P >0.05 N= Number of respondents, σ = Standard Deviation

Table 4 is the result obtained when hypothesis two was tested at 0.05 level of significance. The p-value stood at 0.726. Since the p-value is greater than the α-value of 0.05, implies that there is no significant difference in the mean response of Lecturers and Information and Communication Technology unit's staff in Universities on the concept mapping competencies required by pre service-teachers. The null hypothesis, H_{O2}, is therefore upheld.

H_{O3}: There is no significant difference in the mean cognitive achievement of student-teachers taught educational technology with the concept maps and those taught without the concept maps.

Summary of one way Analysis of Covariance (ANCOVA) for test significance on the effect of achievements either concept map and conventional method on cognitive achievement test

Dependent Variable: posttest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	329.900a	2	214.950	1.389	.277
Intercept	6441.368	1	6441.368	62.114	.000
Pretest	261.268	1	272.268	2.272	.137
Treatment	177.298	1	177.298	1.685	.177
Error	4884.732	46	105.392		
Total	307736.010	49			
Corrected Total	5211.713	48			

a. R Squared = .053 (Adjusted R Squared = .012)

b. Significant at sig of F <0.05, not Significant at sig of F>0.05

c. R (1, 46) =49 p= 1.7 partial eta squared =.28

The data presented in Table 4 shows one-way between-group analysis of covariance that was conducted to the effect of concept mapping on two different groups of Yobe State University students in teaching and learning educational technology cognitive achievement test. Students' scores on concept mapping were used as the covariate in this analysis. The F- calculated value at degree of freedom (1, 68) is 2.77 with a significance value of 1.77 which is above cut-off of .05 the null-hypothesis (H_{03}) is accepted at .05 of significance which implies that there is no significant difference between the mean the score of students that used concept map and students that used coventional method in learning educational technology. Therefore, the use of both instructional delivery techniques is effective in teachings and learning.

Findings of the Study

1. Concept mapping competencies required by student-teachers Technology Education teachers educational technology include: video conferencing, online whiteboard for real-time collaboration, instant messaging, participation control, breakout rooms, screen sharing, file annotations, video playback, quizzing tools, and tools for movable partition walls

2. Concept mapping competencies required by student-teachers in educational technology include ability to: multitask in concept mapping environment, create a comfortable learning environment to students using the virtual platform, build rapport with the students and communicate effectively, high level of the concept mapping technology mastery and mastery of the subject matter, and effective time management.
3. There is no significant difference in the mean response of student-teachers Educational Technology lecturers and Information and Communication Technology unit's staff in Universities on the concept mapping competencies required by student-teachers in educational technology.
4. There is no significant difference in the mean response of students-teachers Educational Technology lecturers and Information and Communication Technology unit's staff in Universities on the concept mapping competencies required by student-teachers.

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