Development and Validation of Digital Concept Maps Package for Online Economics Instruction in Senior Secondary Schools

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Abstract:

The use of computers in education and instruction is on the high side now given the recent crop of digital learners in this digital era. Technological-based learning is a way of pacifying the today's technology-hungry learners. Therefore, this study was aimed at developing and testing the efficacy of Digital Concept Maps Package (DCMP) for online Economics instruction in senior secondary schools. The study was a research and development study that used quasi experimental pretest-posttest non-equivalent control group design. The population of the study was 986 SS2 Economics students in Nsukka Local Government Area of Enugu state. The sample of the study consisted of 201 SS2 Economics students from six secondary schools in the zone. The instrument for data collection was Economics Achievement Test (EAT). The EAT was face validated by seven experts from University of Nigeria, Nsukka. EAT has a reliability index 0.72 using Kuder – Richardson (K-R). The experts also validated the developed DCMP using a Validation Rating Scale (VRS). The data analysis was done using Mean, Standard Deviation and ANCOVA. The findings of the study showed that experts' validation ratings of DCMP were very high and that the students' mean achievement score in DCMP group was significantly higher than that of their counterparts taught with lecture method in the control group. The researchers concluded that DCMP is very effective in enhancing students' achievement in Economics. The implication of the findings is that both Economics teachers and students need to start using DCMP for online instruction in Economics for better students' achievement.

Keywords: Digital Concept Maps Package (DCMP), Economics education, Online learning, Secondary education.

Introduction

Economics deals with decision making on daily basis which made it to have root in all human actions. The problem of scarcity in society has made the study of Economics very prominent as decisions are to be made on the best possible endeavours to expend the available resources to get optimal utility. Accordingly, the focal attention of the study of economics

is the production, distribution and consumption of goods and services for the most optimal level of benefit (Mohammed & Pitan 2022). This implies that the hub of Economics is the optimization of scarce resources. Economics is defined as a secondary school subject that studies choices and decision making in the face of unlimited wants and scarcity of resources at both individual and societal levels.

In Nigeria, Economics is one of the subjects in the senior secondary school curriculum. In the curriculum provided by the Nigerian Educational Research and Development Council (NERDC, 2014), Economics curriculum deals with all the objectives, themes, topics, teachers' and students' activities for attainment of economic and broad educational goals. Economics is a subject that facilitates judicious decisions and better choices among students in face of scarce resources and unending wants. Amuda et al. (2016) noted that Economics informs and provides the possible consequences of some actions. This helps in choosing wisely from several alternatives and makes one to be a responsible rational citizen.

Despite the importance of Economics for all round development, students' learning outcomes in Economics tend not to be cheering. In this line, the West African Examination Council (WAEC) Chief Examiner's Reports from 2017 through 2019 revealed that students' achievement in Economics has been consistently poor (West African Examinations Council, 2017, 2018, 2019). In 2017, 2018 and 2019, the Chief Examiners reported significant drops/decline in candidates' performance when compared to those of the previous years. The reports showed further that a good number of candidates showed great deficiency in mathematical and graphical analyses and representations to economic analysis leading to the poor achievement recorded (West African Examinations Council, 2017, 2018, 2019). Eleje et al. (2020) attributed this state of affairs majorly to the pessimistic outlook or stance that students have for mathematics or subjects requiring graphical and mathematical skills.

Another reason given for students' poor learning outcomes in Economics is an ineffective mode of instructional delivery or teaching methods/strategies/approaches used by teachers (Eze, 2021; Mohammed & Pitan (2022). The NERDC (2008) recommended that teachers should use collaborative, interactive, and learner-oriented instructional strategies and also listed concept mapping as one of the strategies for teaching Economics. Some researchers have investigated some innovative teaching approaches. Accordingly, Nji (2023) compared the effects of Peer-to-Peer and Peer-Led-Team Learning

strategies on students' engagement and achievement in secondary school graphical analysis content in Economics. Lin (2021) developed a classroom experiment to illustrate the specific-factors model. Eneogu (2017) carried out a study on students' Team Achievement Division (STAD) and Team Accelerated Instructional (TAI) techniques on students' engagement and achievement in senior secondary school quantitative Economics contents in public secondary schools. Ekweoba (2014) and Nji (2023) investigated the effect of Problem based Learning (PBL) on students' interest in Economics. Additionally, computer-based learning resources in Economics education are available in the literature; for example, Gilbert and Oladi (2011) introduced the Heckscher-Ohlin-Samuelson model using Excel software for international trade. Ekweoba (2014) investigated the effect of Computer Concept Mapping (CCM) on students' achievement in Economics.

From the above, these innovative teaching approaches used in teaching Economics proved very effective in the respective studies. However, Yusuf et al. (2020) revealed that the dominant conventional approach to teaching using lecture methods by Economics teachers in Nigeria over the years has led to students' average academic performance in the subject. This has made some researchers to call on instructors to apply teaching methods, instructional modes or strategies that increase students' participation in Economics Yusuf et al. (2020), while also taking advantage of technological advancement in this digital era (Esege et al., 2022; Eze, 2021; Mohammed & Pitan, 2022).

Technological advancement and computer networks have made it easier to source of information on the Internet, creating computer-based learning resources and even engaging in Internet or online instructional delivery. As it relates to this study, online instructional delivery deals with students' learning through the Internet or web-based materials where educational resources are made available for students through the Internet or online. In online instructional delivery, students are provided with the website(s) they need to visit to get a given task done. Rashid et al. (2016) stated that online learning is the utilization of computer network systems to study content in order to achieve a certain cognitive level. According to Roblyer and Doering (2013), the objective of online learning has to do with learners sourcing information or accessing resources on the internet and accomplishing a task or tasks with such information. As they are able to get the information, they may be required to show its meaning, assemble and blend different

sources, or analyze its value. The authors further noted that the activity should not be just knowledge sourcing, but calls for further, high-demanding tasks after the students find the information. In view of this, Murdoch and Lin (2023) suggested that what seems to be helpful by an instructor might be deemed patronizing by a higher-year student considering their future beyond university. However, a first-year student might be seeking support, structure, and guidance from their instructors.

The effectiveness of online instruction has been reported. Coman et al (2020) observed that the use of online learning proves to be useful, and effective, and has a positive influence on students' performance. Faloye and Obateru (2021) reported that there was a significant effect of online instructional packages on pre-service English language teachers' learning outcomes. Therefore, the need for online instructions cannot be overemphasized, especially with the impacts of the recent COVID-19 pandemic. During the pandemic, many schools alongside other institutions and activities with physical face-to-face classes and contacts across the globe were shut down Ali (2020) bringing academic activities in Nigeria to almost a total halt. With the lessons learned from the COVID-19 pandemic, academics are now faced with the challenge of developing and delivering their lesson contents without jeopardizing their health or even life and at the same time, ensuring high-quality instruction and improved learning outcomes. Because of this, online content delivery is seriously gaining momentum and popularity unlike before across the globe. This further underscored the need for this current study on online instruction in Economics.

Online instructions are delivered using some teaching and learning strategies. Some of these teaching and learning strategies include concept maps, problem-solving, simulations, online discussions, collaborative learning, multimedia learning, and animations among others. In this study, concept maps (CM) are used for online Economics instruction. The reason for choosing the concept map was because the researchers suspected that it would aid students' understanding of graphical contents in Economics (that have been pointed out as a source of students' poor achievement) because of its (CM) graphic nature and ability to summarize complex information simply at a glance (dos Santos et al., 2017).

A concept map is the graphical or schematic representation of concepts and relationships among them in nodes and directed arcs or arrows. The nodes show the concepts or ideas in a field of knowledge,

and the labeled directed arcs are associations that are the connections among concepts (Álvarez-Montero et al., 2015). A concept map allows a learner to discover the connectedness between ideas or concepts by making a visual schema of the connections.

Concept maps give learners the prospect of concretizing their thoughts in a chart or schematic form. The schema from a concept map tends to provide a good summary of the information it provides. This makes concept mapping a useful tool to recapitulate a multifarious composition of textual information and contribute to discovering the main points in a piece of writing(dos Santos et al., 2017). This is because schemas enable viewers to take out information or knowledge within the least possible time and with less effort.

Concept maps may well be done physically by hand using pen and paper (i.e. Manual Concept Maps) or using a computer (i.e. Computer or Digital Concept Maps). Manual Concept Mapping (MCM) is generating concept maps with pen and paper. It generates concept maps manually without any computer application or software. MCM could be frustrating because it is very difficult to revise or modify. This necessitated the need for digital or computer concept maps. A Digital Concept Map (DCM) is the representation of knowledge by visualizing relationships among concepts in a digital or computer environment or using computer software or tools. According to Uygur (2019), digital concept maps are generated by designing concept maps in a digital setting using computers (mobile or non-mobile devices) and using them in the educational environment. With computer or digital assistance, the revision of the concept map will be easy for students to build and draw (Wang, 2020). Therefore, a digital concept map provides a very flexible and fluid-free environment that accommodates changes and alterations neatly and easily. Some of the computer software for concept maps include CMAP, Inspiration, Smart Draw, and Concept Map EDitor® among others. CMAP software was used in this study. This was because it was very convenient easy to use and understandable for SSII students used in the study.

Literature Review

This study is anchored on Ausubel's theory of learning. Hewett (1963) noted that individuals identify, join, and integrate new knowledge into higher-level concept groups. Ausubel viewed knowledge as a

representation of an inclusive system in which concepts are connected in an organized way. An individual's brain follows a rational system for categorizing information. Ausubel distinguished between rote learning and meaningful learning. Rote learning, according to Ausubel, is when an individual does not attempt to make connections between new information and related existing information in the brain. On the other hand, meaningful learning occurs when an individual substantively incorporates new ideas or knowledge with the already related existing knowledge. With meaningful learning, one's intellectual makeup is built by incorporating new ideas or concepts into one's existing conceptual structure.

Meaningful learning is based on the incorporated structure of ideas/concepts and postulations arranged in the hierarchy for a particular field of knowledge. In concept maps, new concepts are subsumed into a bigger and more general set and subsequently regroup the new and old information as a whole. A concept map is a good tool used to build upon earlier knowledge by connecting new information back to it. A concept map tends to be a good mode of instructional delivery in Ausubel's learning theory.

Previous knowledge is very significant in learning new concepts according to Ausubel. The incorporation of new ideas/concepts into the learner's existing conceptual structure marks learning in Ausubel's theory. For this theory, an individual's intellectual makeup is arranged in hierarchy. Concept maps are predisposed to this makeup/structure. They order concepts and ideas in hierarchy and sequence, bringing out the connectedness in concepts. Concept maps are analogous to individuals' intellectual structures as they present concepts in logical hierarchy giving room for meaningful learning as pointed out in Ausubel's theory.

Furthermore, Ausubel was heavily inspired by Piaget, who developed ideas in the constructivist view of learning. In this view, learning is an active process where learners construct meaning and knowledge, rather than just passively take in information. In concept mapping, students are actively engaged in constructing their own meaning and knowledge as they try to make connections and link concepts and ideas. In addition to this, Bruner (1966) posited that learning is a progression of individual

perception and the advance in meaning through active ways. Bruner also viewed learning as activity based where learners create their own meaning based upon their present/past knowledge and social relations. By so doing, content is not abstract and strange. Rather it is familiar and then learned in ways that are real and authentic, which gives room for wider applications in similar contexts. Bruner noted that learners need to be presented with instructional approaches and supple tools to engage them. DCMP is therefore, assumed to present learners with the opportunity of being actively engaged in teaching-learning process as learners try to visual their understanding of concepts and ideas and the relationships among them.

Many researchers have carried out various studies on efficacy of Computer or Digital Concept Maps on students' learning and other related factors. For instance, Mashhadi, Ahmadi, and Rajabi (2021) investigated the impact of computer concept mapping on Iranian EFL learners' writing complexity and accuracy and find out that computer concept mapping instruction (CCMI) entailed significantly better writing performance. Aşiksoy (2019) found out that teaching in the computer-based concept mapping (CBCM) environment combined with Google Classroom provided meaningful learning by correcting the misconceptions of the students in sustainability of concept with a significant increase in the problem solving skills. Chang et al. (2016) reported that the Computer-based Concept Mapping group students scored higher than the non concept mapping group students on the cognition, understanding and higher order thinking subtests in Physics. The findings of the aforementioned studies clearly provided evidence on the efficacy of Digital or Computer Concept Maps. However, none of the studies to the best knowledge of the researchers used Digital Concept Map as a package for an online instruction which was the crux of the present study.

Therefore, the purposes of this current study were: to develop and validate Digital Concept Maps Package (DCMP) for online Economics instruction in secondary schools and to determine its effectiveness. Hence, the study provided data on experts' validation ratings of DCMP as part of its validation process of DCMP. And to determine the effectiveness of DCMP, the mean achievement scores of students taught Economics using DCMP and those taught using lecture method were investigated. These formed the basis for the research questions and hypothesis.

Research Questions

1. What are the experts' validation ratings of DCMP?

2. What are the mean achievement scores of students taught Economics using DCMP and those taught using the lecture method?

Hypothesis

HO: There is no significant difference in the mean achievement scores of students taught Economics using DCMP and those taught using the lecture method.

The development of the Digital Concept Maps Package (DCMP)

The main product of this study is the Digital Concept Maps Package (DCMP) for online instruction in Economics. The research and development design was used for this study as the study designed, developed, validated, and determined the effectiveness of the DCMP. Research and development involves systematic processes known as the cycle of R&D or R&D model. Many scholars have proposed different models with varying components and steps. For example, McKenney and Reeves (2014) and Plomp and Nienke (2013) proposed three steps which are problem analysis, design and development prototype, and evaluation. Easterday et al. (2014) proposed six steps which are to focus on the problem, understand the problem, define goals, conceive the outline of a solution, build the solution, and test the solution. Wongyai and Patphol (2018) proposed four steps for curriculum or instructional innovation which are analyzing foundational data, designing the innovation, implementing the innovation, and evaluating and improving the innovation. The model adopted in the study for the development of the DCMP for online instruction was the Wongyai and Patphol model (Wongyai, & Patphol, 2018). Wongyai and Patphol's model was adopted because it met the purpose of this study which was to develop, validate, implement, and evaluate DCMP for online Economics instruction.

The first step in the adopted model for the study is analyzing foundational data for designing innovation. This step (analysis) deals with a needs assessment by analyzing and synthesizing concepts, theory, research findings, and experts' opinions (Wongyai & Patphol, 2018). Researchers have noted the unsatisfactory learning outcomes of students in Economics, as highlighted in the reports from WAEC Chief Examiners. They have also recognized the suspension of academic activities, along with other

engagements, during the COVID-19 pandemic in Nigeria in 2020. In response, they aimed to develop an alternative instructional delivery method that would enhance students' learning outcomes in Economics and ensure the continuity of academic activities despite the challenges posed by lockdown measures.

The second step of the adopted R&D model is designing the instructional innovation. The instructional innovation in this study is the Digital Concept Maps Package (DCMP) for online Economics instruction for SSII students. The DCMP was mapped at this second stage. The DCMP was designed by the researchers by first downloading the free digital concept mapping software app – CMap® from http://CMap.ihmc.us. The concept mapping software - CMap® was developed by the Florida Institute for Human and Machine Cognition (IHMC). The software features an easy-to-use operation interface with concept nodes and linking words/phrases and easy annotation (on each concept in a node (if one wishes).

The researchers used the units of SSII Economics curriculum to identify the contents and objectives to be covered in the DCMP. The contents chosen (utility, price mechanism legislation or control, and elasticity of demand and supply) were based on the reports of WAEC Chief Examiners that students' poor achievement in Economics was rooted in their poor knowledge of graphical and mathematical Economics contents. The chosen topics have a graphical and mathematical undertone. Based on the chosen contents, the DCMP has five modules. They are: Modules on Utility, Price Mechanism, Price Legislation, Elasticity of Demand, and Elasticity of Supply. Each module has five interfaces, which include the objectives, readiness activity, map, study questions, and multiple-choice questions.

The objectives interface is where the objectives of each module are stated. They are statements of expectations of the researcher from the students by the end of each module. The objectives for utility and elasticity of demand are in all ten and thirteen in number respectively. The objectives are split according to the three maps each generated under the topics – utility, and elasticity of demand due to their robustness. The objectives for Map I, Map II, and Map III are three, four, and three respectively for utility. For elasticity of demand, the objectives for Map I are five, while Maps II and III have four objectives each. The objectives for price mechanism, price legislation or control, and elasticity of supply are five, four, and four in number, respectively.

The readiness activity interface contains set induction activities for each module. They are mainly thinking activities relating to the topics. The activities are on everyday economic happenings around the students and spurring them to think out why such events turn out the way they do. This makes them get excited and ready to get answers to their questions and curiosity.

The map interface contains the actual concept map for each module. All five topics of focus in this study are mapped out individually by the researcher. The maps have other hyperlinks for additional attachments like formulas, calculations tables, and graphs/diagrams. The attachments are in form of texts and images embedded in the maps. These give detailed information on the topics mapped for deeper understanding. The concept maps for utility and elasticity of demand modules are three separate maps each designated as Map I, Map II, and Map III. This is because of the robustness of the topics as they could not be mapped on a single concept map.

The interface for study questions contains essay questions on the module studied. The questions were posed to help test students' understanding of the maps. The study questions for utility, price mechanism, price legislation or control, elasticity of demand, and supply are 10, 5, 4, 8, and 4 in number, respectively.

The interface for multiple-choice questions contains multiple-choice items for each topic. The questions or quizzes are created with Google Forms and embedded in each module. The students were to respond to all the items with each item having one point. The students were automatically scored at the end of each quiz with a review of the answers to help correct students' misconceptions or wrong answers. The multiple-choice questions for utility, price mechanism, price legislation or control, and elasticity of demand and supply are 15, 10, 15, 20, and 10 in number, respectively.

The researchers provided a user guide for the DCMP. The DCMP was uploaded onto the internet through CMap cloud and then uploaded to a website under WordPress for students' access to the DCMP. The website address for the package is tooeducere.wordpress.com/economics-instructional-packages/ with the password – PhD package. Still, at this second step, DCMP was validated.

The third step in the adopted R&D model is implementation. This step has the objective of implementing the instructional innovation with the sample or target group of research. The final step in the adopted R&D model is the evaluation and improvement step. In this study under this step, the

researchers determined the difference between mean achievement scores of students in DCMP and lecture method groups. The higher mean achievement score of students in the DCMP group proved its effectiveness for online instruction. The necessary improvements on the DCMP were then made. The research and development flowchart for DCMP is shown below.

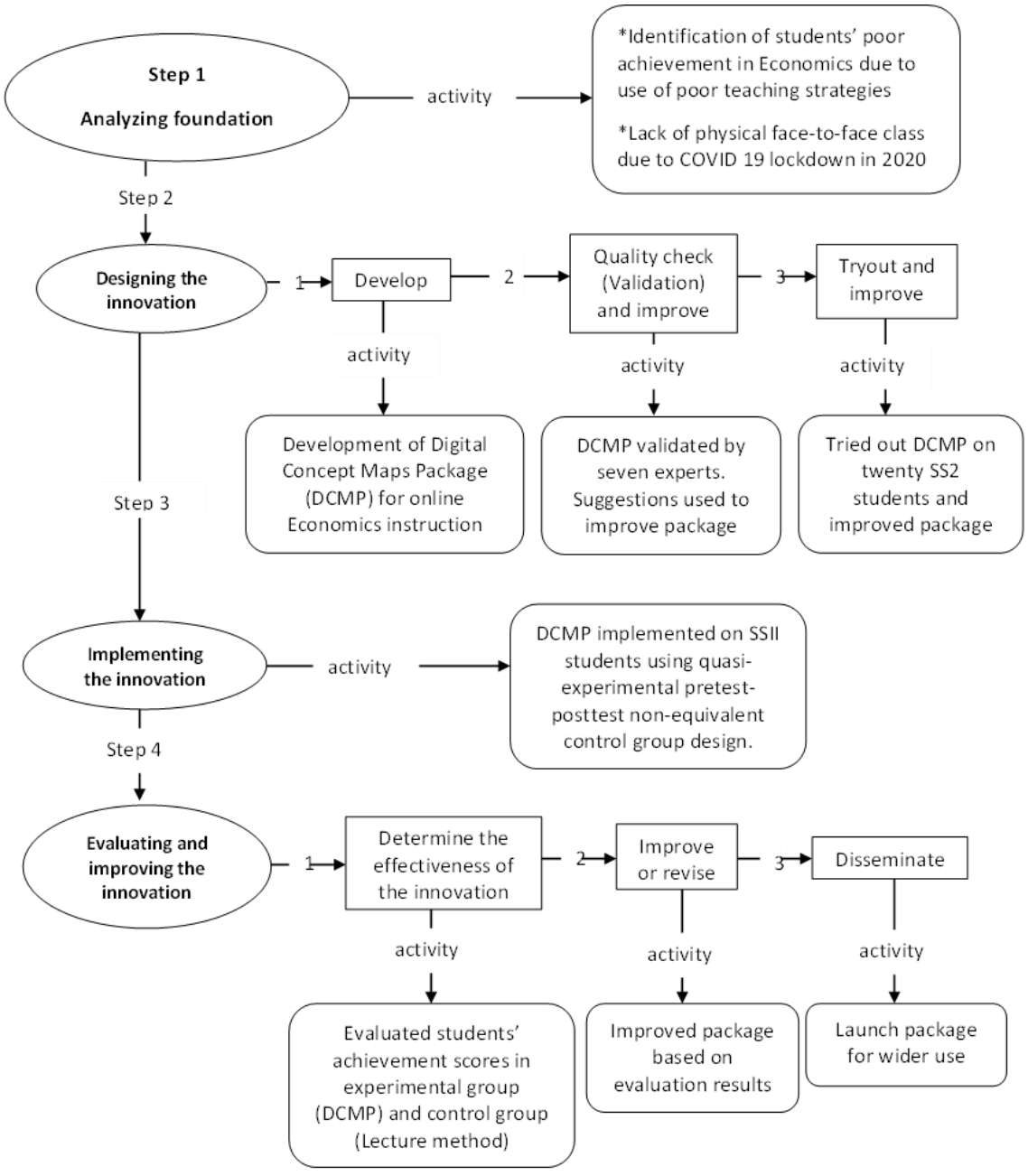

Figure 1. Research and Development Flowchart

Research Methodology

This study was a research and development study (R&D) with a quasi-experimental pretest-posttest non-equivalent control group design. Research and development is research that aims at developing, validating, and testing the efficacy of educational products and services which may be textbooks, equipment, or curricula (Nworgu, 2015). The population of the study was 986 SS2 Economics students from the 32 secondary schools in Nsukka Local Government Area of Enugu State. The sample size was 201 SS2 Economics students. A simple random sampling technique was used to draw six schools from the 32 secondary schools in Nsukka LGA. All the SS2 Economics students from the six schools totaling 201 were then used for the study.

The instruments for data collection were the Validation Rating Scale (VRS) and Economics Achievement Test (EAT). VRS was a researchers-constructed 20-item rating scale. It has statements on the appropriateness of the developed DCMP for online Economics instruction. The rating scale was a five-point rating scale in ascending order ranging from 1 to 5 where 1 represents poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent. Using real limits of numbers, any item in the rating scale with a mean score of 1.00 to 1.49 is adjudged poor; 1.50 to 2.49 is adjudged fair; 2.50 to 3.49 is adjudged good; 3.50 to 4.49 is adjudged very good; and 4.50-5.00 is adjudged excellent.

The Economics Achievement Test (EAT) was used to measure the student's achievement in Economics. The EAT was a multiple-choice type of achievement test. The items in the test were adopted from WAEC's past question papers spanning from 1991 to 2021. They border on the topics covered in this study, namely – utility, price mechanism, price legislation, elasticity of demand, and elasticity of supply. The test contained 50 multiple choice items with four options lettered A-D each. Students would choose the correct answer from the list of options provided for each item. The 50-item test scored one mark for each correct response.

The DCMP was validated by seven experts - three Economics Educationists, one Measurement and Evaluation expert; two educational technologists, and one software/multimedia development expert using the Validation Rating Scale (VRS). Each of the components/interfaces of the DCMP was validated for coverage and suitability both for the chosen contents and for the students. The EAT was face-validated by

the same seven experts that validated the developed DCMP. EAT has a reliability index of 0.72 using Kuder – Richardson (K-R).

For the data collection, the six sampled schools were randomly assigned to either experimental group (DCMP) or control group (lecture method) with three schools making up one group. EAT was administered to the experimental and control groups before the introduction of the treatment - DCMP and lecture method respectively, and re-administered to the two groups after the treatment. Both the experimental and control groups covered the same learning contents using the developed DCMP and lecture method, respectively.

Mean, Standard Deviation and ANCOVA were used for data analysis. ANCOVA was used to determine the significant differences in the mean scores of students as 0.05 probability level. ANCOVA was used because there was no randomization. It was used to avoid the error of non-equivalence and effect size and reduce the initial group differences due to the non-randomization of subjects. It helped to block off the effect of pretest on posttest by treating the pretest as a covariate.

Results and Discussions

The data on Table 1 showed that experts rated DCMP very highly. Apart from items 1 and 12 that were rated good, all the other items were rated very good (items 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 19, and 20) and excellent (items 11 and 18). The grand mean of 4.08 indicated that DCMP was rated very good by experts. This showed that DCMP is appropriate and suitable for SS2 students' online instruction in Economics.

Research question one: What are experts' validation ratings of DCMP?

Table 1: Experts' Validation Ratings of DCMP

SN	Item Statement	Mean	SD	Decision
1	The objectives are clearly and adequately stated in the DCMP.	2.86	2.04	G
2	The objectives adequately cover the selected contents in the DCMP.	4.00	1.83	VG
3	The readiness activities are adequate for the contents and students.	3.86	0.69	VG
4	The concept maps in the DCMP are well prepared and detailed.	4.00	0.82	VG
5	The maps adequately cover the selected contents.	4.43	0.53	VG
6	The maps are clear and easy to understand.	3.71	0.76	VG

SN	Item Statement	Mean	SD	Decision
7	The linked tables, graphs, formulas and calculations in the concept maps are clear and well explained.	4.14	0.90	VG
8	The study questions adequately cover the stated objectives.	4.29	0.76	VG
9	The study questions are within the selected contents.	4.29	0.49	VG
10	The study questions are within the students' ability level.	4.43	0.53	VG
11	The multiple-choice questions are adequate for the contents.	4.57	0.53	E
12	The total scores and correct answers given as feedback at after answering the questions are well presented.	3.29	2.29	G
13	The DCMP is well suited for SS2 students.	4.43	0.53	VG
14	The DCMP is easy to understand.	4.14	0.69	VG
15	The DCMP is easy to navigate/operate.	3.71	1.50	VG
16	The design of the DCMP is very attractive.	3.71	0.76	VG
17	The DCMP is sequentially presented.	4.29	0.76	VG
18	The quality of texts, tables and graphics in the DCMP are good.	4.71	0.49	E
19	The DCMP has correct use of grammar.	4.29	0.49	VG
20	The DCMP is capable of promoting learning.	4.43	0.53	VG
	Grand Mean	**4.08**	**0.54**	**VG**

Key: G – Good; VG – Very Good; E - Excellent

Research question two: What are mean achievement scores of students taught Economics using DCMP and those taught using lecture method?

Table 2: Mean Achievement Scores of students taught Economics using DCMP and those taught using Lecture Method

		Pretest		Posttest		
Group	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean Gain**
Experimental (DCMP)	94	25.47	4.33	43.16	3.62	**17.69**
Control (Lecture method)	107	25.79	3.98	35.65	3.47	**9.86**

From Table 2, the information indicated that the DCMP group had a pretest mean achievement score of 25.47 with SD of 4.33. The control group had a pretest mean achievement score of 25.79 with SD of 3.98. This implies that the two groups' achievement scores were roughly at par before the experiment. The posttest mean achievement score for the DCMP group is 43.16 with an SD of 3.62, while that of the lecture method group is 35.65 with SD of 3.47. The low SDs indicated that the scores are at close range. The DCMP group had a mean gain of 17.69 while the control group had 9.86. This showed that DCMP enhanced students' achievement scores in Economics more than the lecture method. Hypothesis **HO:** There is no significant difference in the mean achievement scores of students taught Economics using DCMP and those taught using the lecture method

Table 3: ANCOVA on Mean Achievement Scores of students taught Economics using DCMP and those taught using Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3168.870	2	1584.435	146.548	.000
Intercept	4942.598	1	4942.598	457.154	.000
Pretest	350.099	1	350.099	32.382	.000
Group	**2893.219**	**1**	**2893.219**	**267.601**	**.000**
Error	2140.713	198	10.812		
Total	313610.000	201			
Corrected Total	5309.582	200			

S = Significant ($p<0.05$)

Table 3 shows that the F value of 267.601 is significant at a 0.000 level of significance. Since this level of significance (0.000) is less than the 0.05 level of significance at which the hypothesis was tested, the null hypothesis is rejected. Therefore, there is a significant difference in the mean achievement scores of students taught Economics using DCMP and those taught using the lecture method.

Discussion

The developed DCMP was rated very high by experts. This confirms the suitability and appropriateness of the DCMP. This may be based on the fact that the developed DCMP is user-friendly and easy to use. This is in accordance with the opinion of Alebaikan and Troudi (2010) who suggested that the design of any online learning activities should be user-friendly, easy to use, and interesting in order to be successfully adopted.

The DCMP supports the learning theory of Hewett (1963). According to Ausubel, the human cognitive structure is organized hierarchically, whereby learning takes place by substantively incorporating new ideas or knowledge with the already related existing knowledge by the learner. The DCMP presented concepts and ideas in hierarchy and sequence, bringing out the connectedness in concepts, which is analogous to individuals' intellectual structures as pointed out in Ausubel's theory. Again, DCMP presented a learning environment that helped students to be actively engaged in the

learning process giving room for personal understanding and meaning development as emphasized by Bruner.

Furthermore, the significant difference in the mean achievement scores of students taught Economics using DCMP and those taught using lecture method observed in this study may be explained by the fact that students of today are of digital age, hence introducing digital technologies in their learning process may arouse their interest and spur them to learn. This supports the observation made by Asogwa et al. (2016) that the integration of computers into the classrooms in Nigerian secondary schools is already common, widespread, and accepted for instructional purposes. Furthermore, the online instruction with DCMP gave students the needed opportunity to source for and assimilate information independently on their own. This made them to be actively engaged in their learning giving them a sense of belongingness in their learning. As such, Uygur (2019) observed that digital learners get motivated more easily in the lesson when the methods containing technology are used in their learning environment. Therefore, DCMP for online Economics instruction is capable of improving students' learning outcomes in Economics.

This finding of this study is consistent with the findings of Esege et al. (2022) (increased performance in CRS with CSOCL-IP), Mashhadi, Ahmadi, and Rajabi (2021) (better writing performance using CCMI), Faloye and Obateru (2021) (significant learning outcomes with virtual instructional packages), Aşiksoy (2019) (significant meaningful learning in CBCM environment), and Chang et al. (2016) (higher score for CBCM group in Physics). Furthermore, the observed significant difference in achievement after online instruction with DCMP supports the observation of Coman et al. (2020) on the usefulness of online learning. Therefore, the use of DCMP for online instruction in Economics cannot be overemphasized given its proven effectiveness in enhancing learning outcomes in Economics.

DCMP being an online learning resource in Economics is student-centered. Students, therefore, need to be trained and exposed to its usage. According to Andersson cited in Wani and Mahdi (2021), the pedagogical model of online learning is mostly student-centered. Since online learning entails a shift from conventional teacher-centered to learner-centered strategy, guidance actions are important for online learning execution, which, if not considered, can become an impediment to online learning adoption.

Students should, therefore, be allowed to learn at their own pace for online learning implementation to be successful.

In a broader educational context, online instructional delivery or tools are a sure way to cater for both onsite and offsite instructional activities. Online instruction promotes access to information for a wide range of students irrespective of the location. Students across the globe can easily access the information; the educational activities accelerate through the use of the internet in education. This has been evidently shown in this study with DCMP.

The implication of the findings of this study for both teachers and students is that they will need to start using DCMP for online instruction since its effectiveness in improving students' learning outcomes has been proven. DCMP for online instruction will enhance students' learning outcomes in Economics contents covered in this study. This implies a better achievement in Economics mathematical and graphical contents in WASSSCE.

This study has contributed to literature as it has helped in developing an online learning package (DCMP) for students in some topics in Economics to help improve students' achievement in Economics. The study has also shown that digital teaching and learning tools are powerful instruments for enhancing learning. The study has shown that the developed DCMP is an effective learning package that is capable of improving students' knowledge and learning in Economics.

Conclusion

Based on the findings of this, the researchers conclude that DCMP is appropriate and suitable for SS2 Economics students. Students' mean achievement score in the DCMP group was significantly higher than that of their counterparts in the lecture method group. This made the researchers adjudge and conclude that the DCMP for online Economics instruction is very effective in improving students' achievement in Economics. The use of DCMP made students to be more actively engaged in their learning.

Recommendations

Economics teachers should start using the Digital Concept Maps Package in their teaching. They should develop more digital concept maps in other contents of Economics and use them for online teaching.

Teachers should use the DCMP for online Economics developed in this study when teaching the contents covered in this study. The curriculum body for secondary education should include the link and refer teachers to the DCMP developed in this study in the Economics Curriculum Document. It should also develop and include digital concept maps for online instructions in other Economics content. Parents and guardians should provide their children and wards with digital devices (android phones and laptops/computers) and data to access DCMP and other online instructions and materials. Government, school administrators, NGOs, and other well-meaning individuals should find a way to provide subsidized customized educational phones targeted for secondary school students for academic purposes only. This will allow every secondary school student to have a phone and access DCMP and other digital and online learning materials. Government, school administrators, NGOs, and other well-meaning individuals should provide laptops/computers with internet connectivity in schools for students to be able to access DCMP and other online instructions and materials.

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The topic of this study was conceptualized by Chinyelugo and Igbokwe (first and second authors). The first and second authors wrote background. Nji (third author) wrote the design under the supervision of Eneogu (fourth author). In developing the instruments, all authors contributed significantly. Eneogu and Agah collected the data. Amedu and Agah analysed the data, interpreted it and discussed the findings. Amedu and Eneogu edited the manuscript.

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