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# Instructional Strategies and Chemistry Students' Variables on Cognition of World Economic Meltdown

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## Abstract

The study investigated instructional strategies (concept mapping, demonstration and guided-discovery) on chemistry students' cognition of world economic meltdown among senior secondary three students in Itu Local Government Area of Akwa Ibom State. It also studied the influence of students' cognitive styles and gender on students' achievement on the concept. Three research questions and three hypotheses guided the study. The study was quasi-experimental research using a pretest-posttest non-randomized design. It was conducted in six public secondary schools selected using purposive sampling technique. A sample size of 300 SS3 chemistry students were used from a population of 1,150 chemistry students. World Economic Meltdown Achievement Test (WEMAT) was a researcher-made instrument while Cognitive Style Measuring Instrument (CSMI) adapted from Uzzi (1999) were the two instruments used for gathering data for the study with reliability indexes of 0.79 and 0.83 respectively. Data obtained were analysed using ANCOVA for the hypotheses at P<0.05. Findings showed significant differences in the effect of instructional strategies on students' achievement on world economic meltdown. Cognitive styles of students and gender significantly influenced students' achievement. Based on the findings, it was recommended among others, that concept mapping strategy should be used in teaching the concept of world economic meltdown.

# 1. Introduction

World economic meltdown has dominated headline news in recent times and is receiving attention from scientists and policy makers worldwide. Soludo (2009) stated that after several years of rapid growth in developing countries, the financial meltdown has ushered in dramatic shifts in the economic landscape with direct implications for education at all levels. The crisis comes at a time of impressive progress in getting more children into schools especially at primary and secondary levels. To keep up this momentum, there is need to expand access to knowledge using effective instructional strategies that develop learners cognition towards global economic crisis. A period of global economic meltdown is a period when there is a general slowdown in the economic activity of a country over a sustained period of time (Ogiemwonyi, 2009). When emphasizing the need to engender effective methods for teaching chemistry in secondary schools, Olaniyan & Lucas (2008) observed that schools have numerous responsibilities, including teaching students observation, critical thinking, mathematical reasoning,

communication and problem-solving. Mastery of these responsibilities by chemistry teachers will give them the opportunity to encourage sound knowledge of world economic meltdown.

Chemistry is a subject made up of concepts that require complex mental processes that involves visualizing, manipulating, analyzing, abstracting and associating ideas. Chemistry properly taught, develop students' conceptual understanding and analytical abilities, and these could be applied to solve practical problems such as global economic crisis. Schools can help fulfil these responsibilities because students can apply the knowledge and skills learned in chemistry to real world situations to improve the quality of learning at all levels. This enhances their self-worth and confidence. Chemistry teachers apply various teaching strategies to achieve lesson objectives. Ndu, Ndang, Ekpeni & Ofem (2010) asserted that teachers use the combination of various teaching strategies for students to have better understanding, internalize and conceptualize the lesson meaningfully. The effect of this is that learning becomes appealing and less boring resulting in a drastic increase in the academic achievement of students.

Chemistry teachers are required to use highly structured instructional strategies; and as Cozzens (1997) remarked, this demands teachers who are knowledgeable about scientific content and pedagogy. Bransford, Brown, & Coking (2000) asserted that effective teaching strategies during global economic crisis should involve:

\*Using appropriate just-in-time learning stimuli

\*Engaging students' preconceptions prior to teaching them new concepts

\*Providing deep fundamental knowledge

\*Organizing knowledge in ways that facilitates information retrieval and application

\*Allowing students more opportunities to define learning goals and monitor their progress in achieving them.

There is much to gain by educating the students about the effects of world economic meltdown on the environment, national sustainability and on education in particular. World economic meltdown has been poorly understood or not understood at all by most students. This may be due to the instructional strategies adopted by the teachers in lesson delivery. In addition, students related variables such as cognitive style, gender and students' ideas of the concept may affect understanding (Abalor, 2010). In an effort to meaningfully teach the concept of world economic meltdown, the adoption of instructional strategies such as concept mapping, demonstration and guided-discovery become viable alternatives that can facilitate proper conceptualization of world economic meltdown.

Concept mapping is an instructional strategy that present key concepts as knowledge maps that act as scaffolds to facilitate learning. Novak and Canas (2006) described concept maps as graphical tools for organizing and representing knowledge in enclosed circles, arrows and box-types to enhance selection, summary and develop construct of the concept. Concept mapping strategy is based on the fact that the most single factor influencing learning is what the learner already knows. It means that meaningful learning results when a person consciously and explicitly ties new knowledge to relevant concepts they already possess. Concepts are generalization of knowledge or ideas conveyed in books, documents, speeches, lectures, and observations. When meaningful learning occurs it produces a series of changes within the entire cognitive structure, modifying existing concepts and forming new linkages between concepts. According to Olaniran (2004) and Omoifo (2005) concept mapping technique is highly efficient in bringing about meaningful learning outcomes that characterize crosslinks between concepts for different domains knowledge with potentials for developing skills for inferring, classification and hierarchical structure taking advantage of students' prior knowledge (Inomesia and Unuereo, 2003).

Guided-discovery is an inquiry-based indirect learning strategy that can start with demonstration in which learners are quizzed in a manner that stimulate thinking out principles based on what they have observed. It aids participants learn to recognize a problem, characterize what the solution would look like, search for relevant information, develop solution strategy and execute the chosen strategy (Borthick and Jones, 2000). Santrock (2004) defined guided discovery learning as a learning strategy in which students construct an understanding on their own. Santrock opined that students have to figure out things for themselves. Guided- discovery involves cognitive processes like observing, measuring, inferring predicting, hypothesizing and testing. Guided-discovery encourage students to work independently so as to deepen content knowledge that will greatly impact on their understanding of lesson introduced, enhance their scientific skills and promote fun and excitement that makes learning very memorable. The strategy requires that students engage in laboratory work, searching ideas in books, identifying problems and finding ways to solve them. In this strategy, the teacher originate the problem to be solved and the learner is closely guided towards the solution of the problem. Students have to dictate a problem, inquire and discover the solution to the problem. Ugamadu (2010) revealed that guided-discovery approach enhanced students' achievement as it enable students to be actively involved in a given task. Doing this enables a learner to internalize learning. With careful and well-structured activities, students' interest increase and content sharing opportunities also This strategy could facilitate students' increase. understanding of world economic meltdown.

Demonstration teaching strategy is a process of showing how ideas work /are used. It is an act of display working of some experiments by the teacher while the learners watch with the intention to act later. This strategy is 'natural method' of teaching and provides foundation for initiative behaviour and apprenticeship training (Duru, 2011). Here, the teacher does whatever the learners are expected to do at the end of the end of the lesson by showing them how to do it and explaining the step-by-step process to them (Ameh, Daniel and Akus, 2007). It is an effective method based on sensory experience and learning by observation and experimentation using all the sensory organs. Demonstration teaching strategy is a method in the laboratory that involves experimentation. It can be carried out by the teacher for students to observe/participate or by a student for both the teacher and other students to observe. With prior knowledge (Dick, 2004) reported that providing students with a combination of behavioural objectives on topics that are taught in chemistry, classroom interaction will be enhanced leading to students better performance.

Cognition is the action of acquiring knowledge through thought, experience or the senses (Hornby, 2000). Cognitive style can be construed as the way an individual processes and structures information whereby objective stimuli is interpreted into meaningful schema. Ridding and Cheema (1991) opined that cognitive style is subsumed in the overall personality and cognitive dimension of an individual which influences attitudes, values and social interaction. One dimension of cognitive style includes field-dependence which is a learning style that relies on information provided by the outer world. Field independence identifies an individual's perceptive behaviour while distinguishing objects and figures from the content field in which they are set. A field - independent learner would locate the figure without wasting time no matter how discreet, whereas the field-dependent learner would take a longer time in locating the figure (Witkin and Goodenough, 1981). Okwo and Tartiyus (2004) found that analytical ability, sharp perceptual focus and greater intellectual curiosity have direct influence on students' achievement because cognitive styles are related to the form which cognitive activities are performed rather than to their content.

The major goal of chemistry education is to cultivate inquiry, knowing and rational mind and provide knowledge and understanding of the complexity of the physical world. This goal emphasizes the importance of education which should be to encourage students of both genders to go beyond the classroom. Education For All (EFA, 2000) also emphasized that education should be accessible to all irrespective of gender. However, when academic achievement of boys and girls in chemistry were compared, some showed significant difference (Olatoye and Afuwape, 2004) while others showed no significant differences in the academic achievement of boys and girls in chemistry (Agommoh and Nzewi, 2003).

## 2. Statement of the Problem

World economic meltdown exist in a macrocosm posing a challenge in cognition to inexperienced minds at the secondary school level mainly because of semantic and financial principles involved in its elucidation which may appear obscure to the learners. These constraints no doubt, can be surmounted by presenting the phenomenon in a microcosm. Brunner (1960) opined that any concept could be

taught a learner at any age. This applies to world economic meltdown implying that the depth of this phenomenon as a subject matter could be matched with the level of cognitive development and ability of the learner. It is therefore imperative that there be essence in presenting this phenomenon in a microcosm through various strategies to enhance its understanding by students.

## 3. Purpose of the Study

This study determined to what extent instructional strategies of concept mapping, demonstration and guided discovery, cognitive style and gender as variables affect students' achievement in chemistry on world economic meltdown.

#### 4. Justification of the Study

This study was necessitated to help the students understand the present economic meltdown across the globe. The current economic crisis can be attributed to dwindling oil prices and fall in value of international currency. These will lead to unemployment, poor social services which will have severe consequences on the future of the students.

## **5. Research Questions**

Three research questions guided the study.

- 1. What are the effects of instructional strategies (concept mapping, demonstration and guided-discovery) on chemistry students' achievement in world economic meltdown?
- 2. How does students' cognitive style influence their achievement in world economic meltdown?
- 3. How does gender influence students' achievement when taught world economic meltdown using concept mapping, demonstration and guided- discovery strategies?

## 6. Research Hypotheses

The following hypotheses guided the study.

- 1. There is no significant effect of concept mapping, demonstration and guided- discovery strategies on chemistry students' achievement in world economic meltdown.
- 2. There is no significant influence of students' cognitive styles (field independent and field dependent) on their achievement in chemistry.
- 3. There is no significant difference in the influence of gender on the achievement of students when taught world economic meltdown by concept mapping, demonstration and guided discovery.

## 7. Population of the Study

The population was made up of all the chemistry students

in the 10 public secondary schools in Itu Local Government Area of Akwa Ibom State.

## 8. Sample and Sampling Technique

Three hundred (300) students were used as sample size for the study. Purposive sampling technique was used in selecting intact class subjects from the population. Two instruments used in the study were;

World Economic Meltdown Achievement Test (WEMAT) and Cognitive Style Measuring Instrument (CSMI)

WEMAT was researcher made and contained 20-multiple choice questions that examined different concepts of world economic meltdown that were of interest to this study namely, economic recession, lowering interest rates, and effects of world economic meltdown on chemistry education. The instrument was administered on the three groups used in the study. The Cognitive Style Measuring Instrument (CSMI) was designed to reflect the different levels of the cognitive objectives adapted from that of Uzzi (1999) and it contained twelve (12) items. Each item contained response that were either field dependent or field independent. Responses of students with maximum of either styles indicated the cognitive style of the student.

#### Validation of Instruments

The two instruments WEMAT and CSMI were validated by two professionals in chemistry education and two lecturers of science education in measurement and evaluation for the construct, content and face validity.

#### Reliability of the Instruments

The two instruments' reliability were determined after administering the instruments to a group of fifty (50) students selected for the purpose who had been taught the concept. WEMAT had a reliability index of 0.78 which was arrived at using split-half approach. CSMI had a reliability index of 0.73 arrived at using the test-retest method. After one week the same instrument (CSMI) was re-administered to the same group of students. The WEMAT contained 20-multiple choice test items. Each correct option attracted two (2) points. The CSMI had twelve (12) items with two options for each item reflecting the field-dependent and filed-independent. The cognitive style with the highest response indicated the type of cognitive style the student, would most likely be.

#### Research Procedure

The study was conducted within the first term of 2013/2014 school year in six secondary schools. Subjects in each school were divided into three (3) groups. Pretest was administered to each of the three groups before actual teaching with the treatment packages. Treatment packages on instructional strategies used derived information for activities from books, speeches, newspapers/magazines, reports, discussion from different media (facebook, television and radio discourse), lectures and observations. It was more interactive with active students' participation on issues of world economic meltdown. There were three (3) treatment sessions for each of the three groups. The teaching packages had similar objectives, content and evaluation to reflect the three instructional strategies. One group was taught by concept mapping strategy while the other two were taught demonstration and guided-discovery strategies with respectively on world economic meltdown. The posttest took place after the treatment session which lasted for three weeks. The two instruments were administered to each group on the same days in all schools chosen for the study.

#### Research Design

The design used in the study was a quasi-experimental pretest-posttest non-randomized group design with intact classes.

The CSMI was administered first, the WEMAT and each instrument was collected after completion of response. This was to guard against information in WEMAT influencing responses in CSMI. Items in posttest were the same as in pretest but were reshuffled. Scripts were collected and marked at the end of the exercise.

#### Data Analysis

Data collected were analyzed using Analysis of Covariance (ANCOVA) with pretest scores as covariates.

#### 9. Results and Discussion

The analysis of covariance was used to test the first hypothesis and the results are presented in Table 1.

1. There is no significant effect of concept mapping, demonstration and guided- discovery strategies on chemistry students' achievement in world economic meltdown.

Source of variation	Sum of square	df	Mean square	F <sub>cal</sub>	Sig. of F	Decision at P<0.05
Pretest (Covariate)	12.240	1	12.240	1.483	0.223	
Main effects (Treatment)	1431.610	2	715.804	86.697	0.000	
Explained	1443.849	3	481.282	58.292	0.000	*Significant
Residual	2443.878	296	8.255			
Total	3887.719	299	13.001			

Table 1. Results of analysis of Cosvariance showing students' achievement classified by treatment.

Table 1 shows that the computed F-value (Fcal) was 86.69, significant at P<0.05. This implied that treatment contributed significantly to students' achievement hence, null hypothesis one was rejected. This meant that there was a significant effect of instructional strategies on chemistry students' achievement on world economic meltdown. The findings of

this study showed that there is a significant effect of instructional strategies on students' achievement when taught world economic meltdown with concept-mapping having the most facilitative effect. This corroborates Olaniran (2004) and Omoifo (2005) that concept-mapping technique is highly efficient and brings about meaningful learning outcomes that characterize crosslinks between concepts for different domains of knowledge when presented as graphical tools for organizing and presenting knowledge to enhance selection and skill development (Inomesia and Unuero, 2003). Concept mapping strategy presented a unique quality of stimulating students' interest in the desire to make sense of scientific information they acquired by selecting and organizing relevant information through crosslinks of different sub-concepts.

Hypothesis two was tested at P<0.05 using the results of ANCOVA in Table 2.

2. There is no significant influence of students' cognitive styles (field independent and field dependent) on their achievement in chemistry.

Source of variation	Sum of square	df	Mean square	Fcal	Sig. of F	Decision at P<0.05
Pretest (Covariate)	12.240	1	12.240	0.984	0.321	
Main effects (Cognitive style)	182.800	1	182.800	14.702	0.000	
Explained	195.041	2	97.520	7.843	0.000	*Significant
Residual	3692.677	297	12.433			
Total	3887.719	299	13.002			

Table 2. Analysis of Covariance showing students' achievement by cognitive styles.

As shown in Table 2, the result indicated 0.000 significance of F which is less than 0.05. This means that the calculated Fvalue of 14.702 is significant at 0.05 level indicating that cognitive style contributed significantly to chemistry students' achievement. This implied that cognitive style had significant influence on chemistry students' achievement on world economic meltdown. Guided-discovery and demonstration strategies were not very effective for the teaching of world economic meltdown because for guided-discovery, more of the learner's

preparedness is required for participation in the learning activity. However, learners that were involved in this study demonstrated little preparedness to learning by discovery.

Hypothesis three was tested at P < 0.05 using the result of ANCOVA in Table 3.

3. There is no significant difference in the influence of gender on the achievement of students when taught world economic meltdown by concept mapping, demonstration and guided discovery.

Table 3. Analysis of Covariance showing students' achievement in world economic meltdown classified by treatment and gender.

Source of variation	Sum of square	df	Mean square	<b>F</b> <sub>cal</sub>	Sig. of F	Decision at P<0.05
Pretest (Covariate)	12.240	1	12.240	1.768	0.184	
Main effects	1732.423	3	577.464	83.442	0.000	
Instructional strategy	1431.608	2	715.804	103.430	0.000	
Gender	300.814	1	399.814	43.466	0.000	
2-way interactions Gender X strategy	115.325	2	57.662	8.331	0.000	*Significant
Explained	1859.990	6	309.997	44.793	0.000	
Residual	2027.719	293	6.920			
Total	3887.719	299	13.002			

The result of the analysis in Table 3 showed that for 2-way interaction of gender and instructional strategy, the Fcal was 8.33 (P<0.05). This implied that gender and instructional strategy contributed significantly to students' achievement. The demonstration method was more teacher-activity based as students' were inadequate and lacking information involving world economic meltdown. The study showed a significant influence of students' cognitive styles on their achievement in world economic meltdown with the field-independent cognitive styles outperforming the field-dependent ones. This is in agreement with Ajevalemi (1998) in Okwo and Tartiyus (2004) who found that analytical ability, sharp perceptual focus and greater intellectual curiosity have direct influence on students' achievement because cognitive styles are related to the form which cognitive activities are performed rather than to their content. The result further implied that there is a significant difference on the influence of gender on students' achievement when taught world economic meltdown using concept mapping, demonstration and guided-discovery strategies. The findings also showed that the influence of gender on achievement in world economic meltdown was statistically significant. The higher mean for females may be due to some positive traits like rational logic, critical and analytical minds the females may have brought to bear during the study period which are essential ingredients that facilitate high academic achievement. The males also possessed identified attributes such as numerical skills that enhanced achievement. This finding corroborates Olatoye and Afuwape (2004) who observed that when academic achievement of boys and girls are compared, they show a significant difference.

## **10. Conclusion and Recommendations**

The study established that concept-mapping strategy as the most facilitative in the teaching and learning of world economic meltdown just as there existed significant influences of cognitive style and gender on concepts that relate with world economic meltdown on their achievement. It was recommended that;

1. Concept-mapping instructional strategy should be used

in teaching world economic meltdown to chemistry students for better conceptualization.

- 2. Teachers should try to appreciate and understand students' cognitive styles and adopt teaching strategies that will favour each cognitive style domain.
- 3. Teaching should be done without gender-bias as both sexes could be exposed to meaningfully participation in the learning process.

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