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FACTOR ANALYSIS OF THE META-COGNITIVE AWARENESS SCALE

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ABSTRACT

Meta-cognitive awareness is concern with a learner's awareness of its own knowledge and the ability to understand, control and manipulate its own cognitive process. This study was design to uncover the underlying structure of the meta-cognitive awareness scale. The scale consist of 52 items. 1017 Senior Secondary School Students drawn from six randomly selected schools were involved in the study . Exploratory factor analysis was conducted using SPSS 16.0. PCA and varimax were used for factor extraction and rotation respectively. Eigenvalues greater than one and factor coefficient greater than .4 were requested. Items which loaded highly in more than one factor and whose factor loadings are .4 and less are discarded. Twenty items were discarded, a second analysis was carried out and the items yielded eight factors that accounted for 89% of the variances explained by the analysi. A confirmatory analysis was conducted to assess the fit of the model to the data. The result shows an excellence fit to the data. The cronbach alpha of internal consistency is .89, which is adequate. The model provides a valid and reliable scale to measure meta-cognitive awareness of Senior Secondary School Student

INTRODUCTION

Most students in the secondary schools are not aware of their learning processes and so cannot regulate them to maximize learning and memory. They are dependent learners who rely on the teachers constant support and so lack confidence in learning to understand concepts they are taught . They view the school system as just passing from one class to the other, and so device different means to ensure they pass from one class to the other without actually acquiring the knowledge they are expected to acquire, at each level of their education, so in SS3 they have not made the necessary connections of concepts they have earlier learned. This has resulted to the poor performance in their WASSCE examination.

It is necessary therefore for students to be aware of learning processes and regulate them to maximize learning and memory in order to make the necessary connection of concepts at each level of their education (Alexander, Jetton, 2000; pressely, 2000; Khabib,2010). Students are not also encouraged to exercise or regulate their cognitive processes as their teachers and parents supply them with all the solutions they need. Therefore Teachers in their classes should encourage student to independently regulate their cognitive processes for a maximum gain in learning (meaningful learning) (Noel, 2006)

The cognitive awareness and the regulation of cognitive processes is known as metacognition (Wikipeia,2010; Pinch, 2006; Nielfield, Laro & osbarne , 2005). Metacognition was fisrt defined by flavel (1979) as the learners awareness of their own knowledge and their ability to understand , control and manipulate their own cognitive process for maximum learning and memory. It is variously defined as thinking about thinking , learning about learning and the process of monitoring ,regulating and controlling an individuals thinking about their thinking (Daniels,2002; Thomas, Anderson & Nelson, 2008; Ormrod, 2006; Khabib, 2010; Chem, Gualbertu & Tamek, 2009).

Metacognition plays an important role in students' learning strategies.

It is the ability to evaluate ones own comprehension and understanding of subject matter and use that evaluation to predict how well one might perform on a task. It refers to the ability to reflect upon the task demand and independently select and employ the appropriate reading , writing or learning strategy .

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It involves self regulation, reflection upon an individuals performance, strength weakness, learning and study strategy. It is the foundation upon which students become independent readers and writers. It also underlies students abilities to generalize maths problem solving strategies. Learning is considered self-regulated goal-oriented situation, collaborative and individually different process of knowledge building and meaning construction (Carte, 2000).

Education is no longer expected to focus solely on the transfer of knowledge but also on the development of metacognition (Pintrich 2002;Thomas & Mee, 2005) .knowledge of cognition is differentiated into declarative knowledge , procedural knowledge and conditional knowledge (Yildiz, Akpinor, Tatar & Ergin 2009). An individual declarative knowledge includes their conceptions and also their belief of task structures.Their cognitive goals and their own personal abilities. . Knowing about one's skill, intellectual resources and abilities as a learner. Procedural knowledge includes information about how cognitive task are performed. This is knowledge about how to implement learning procedures. It require students' knowing the process as well as when to apply process in various situations. Conditional knowledge includes their understanding of both the value and the limitations of their procedural knowledge and knowing when , how and why procedures should be used (Schrew, Crippan & Harley, 2006; Thomas & Mee, 2005; Pintrick , 2002)

Regulation of cognition includes: Planning, which is setting of goals and allocation of resources prior to learning . Information management which involves skills and strategy sequences used to procecess information more efficienly. Monitoring which involves the assessment of one's learning or strategy use. Debugging strategies which has to do with strategies used to correct comprehension and performance error, and Evaluation which is the analysis of performance and strategy effectiveness after a learning task.

THEORITICAL FRAMEWORK

Meta-cognition is based on the "stage theory'' model of information processing by Alkinson & Shriffin (1968) this focus on how information is stored in the memory, it proposes that information is processed and stored in three stages and that information is processed in several discontinuous manner as it moves from one stage to the other. The theory explains that information is received by the receptor cells and is transuded to something the brain can understand. In the process of transduction a memory is formed called the Short Term Memory which is also the working memory. Information that get to the short term memory are said to either have an interesting features or known pattern which attracts the individual's attention. Processed information in the short term memory moves to the long-term memory for easy recall while unprocessed information fades away.

A lot of research have been carried out on the validation of meta-cognition scale; there have been some on meta-cognitive reading awareness inventory for tertiary level (Chen, Gualbertor & Tameta, 2009), others have been for primary school children (Akpinar & Ergin 2009; Sperling el at, 2002; Tuckey, Cetinkoys & Erklin, 2002; Janger, Jansen and Razigt, 2004) and yet others for metacognitive self regulation (Niemczyk & |Savenve, 2005). From these research works there is no metecognition scale developed for secondary school students. It has been suggested that if students metacognition ccan be improved then it should be possible to improve their learning outcomes (Thomas, 2003). Therefore metacognition awareness is very important in the improvement of learning process of students as its application leads to transfer of information in to the long term memory for easy recall, and so there is the need for validation of more scales on metacognition for secondary school students in other to help them improve their metacognition for meaningful learning. Hence this study is aimed to validate the metacognitive awareness scale using factor analysis.

FACTOR ANALYSIS

Factor analysis is a statistical technique used for data reduction and factor structuring. It reduces attribute space from a large number of variable to a smaller number of factor. There are two types of factor analysis ; the Exploratory factor analysis (EFA) and Confirmatory Factor analysis.(CFA). EFA is used to uncover the possible underling structure of a set of observed variables without imposing a preconceived structure on the outcome (Surhr,2008; Raykoy & Marcoulide, 2010). The number of factors generated from a set of observed variables is called the factor structure or model. While the Confirmatory factor analysis is statistical techniques used to verify the factor structure of a set of observed variables. It allows for the test of

the hypothesis that a relationship between observed variable and their underling latent constructs exist. The researcher used the knowledge of the theory or empirical work or both to postulates the relationship pattern aproir and then test the hypothesis statistically. The EFA approach is a date driven approach in which a model or theory is created where as CFA is a theory model driven approach where a model or theory is tested.

METHOD

SAMPLE

This study was carried out on 1017 students from six randomly selected schools in Rivers State. Four were mixed and two were single ; one boys and the other girls. 48% of the sample were female while 50% were males and 2% did not indicate t`heir sex.

INSTRUMENTATION

The instrument was the metacognitive awareness scale by Schraw and Dennison (1994). It consist of 52 items. A 5-point likert scale was used which range from never (1), only occasionally (2), sometimes (3), usually (4) and always (5). The instrument was administered to the sample and analysis was carried out.

ANALYSIS

Exploratory factor analysis was carried out using SPSS 16.0. the Bartlett test of sphericity and Kaiser-meyer-olkin (KMO) indicates that the data was adequate for factor analysis. Principal Component analysis (PCA) and varimax were requested for factor structure and factor rotation respectively. Factor loadings of .4 in agreement and above was also requested in agreement with Seong,(2002) , Yang (2006) and Hashin & Sani,(2008) who stated that .4 is a common cut-off value for factor analysis. . The SPSS default ,eigenvalue greater than 1 criteria was used for number of factors retained. The analysis revealed twenty items which loaded highly on more than two factors and below .4 .These items were eliminated and another analysis was carried out which resulted to eight factors that accounted for 88.7% of the variance explained . A confirmatory factor analysis was conducted (CFA), CFA plays the role of validating the scale (Harrington,2010). Amos 18.0 was used for the CFA to assess the fit of the model to the data. Fit statistics evaluated were X^2 /df: chi-square degree of freedom (CMIN/DF), the Tucker Lewis Index (TLI),Comparative Fit Index (CFI), Goodness of Fit Index (GFI) and Root Mean Square of Error (RMSEA) in agreement with Hair el at (2010). Cronbach alpha reliability was computed for each factor and the total scale.

RESULT

TABLE 1 The KMO and Bartlett test of sphericity

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.974
Bartlett's Test of Sphericity	Approx. Chi-Square	13109.015
	Df	373
	Sig.	000

Table 1 shows the KMO of .974 which is above the .5 acceptable criteria.

The Bartlett test of sphericity test is X^2 =13109 (df=37) which is significant at $p < .05$. This indicates that the data have multivariate normal distribution and so it is adequate for factor analysis.

Table 2 shows the eight factor model that emerged from the exploratory factor analysis of the data. This account for 89% of variance explained. The items loaded highly in each factor but higher in factor one, item loadings ranges from .742 to .982 which is an indication that items in the same factor are measuring the same construct.

Factor Analysis of the Meta-Cognitive Awareness Scale

TABLE2.The factor structure of the meta-cognitive scale

Rotated Component Matrix[a]

		Component							
		1	2	3	4	5	6	7	8
Q6	. I think about what I really need to learn before I begin a task	.920							
Q8	. I set specific goals before I begin a task	.918							
Q22	. I ask myself question about the material before I begin.	.978							
Q23	I think of several ways to solve a problem and chose the best one.	.968							
Q42	. I read instructions carefully before I begin a task	.858							
Q45	. I organize my time best to accomplish my goals.	.887							
Q1	I ask myself periodically if I am meeting my goals		.836						
Q11	. I ask myself if I have considered all options when solving a problem		.823						
Q21	. I periodically review to help me understand important relationships		.813						
Q28	. I find myself analyzing the usefulness of strategies while I study		..806						
Q47	. I try to break studying down into smaller steps		.798						
Q31	. I create my own examples to make information more meaningful			.896					
Q34	I find myself pausing regularly to check my			.886					
Q39	. I try to translate new information into my own words			.763					
Q41	. I use the organizational structure of the text to help me learn			.753					
Q2	I consider several alternatives to a problem before I answer .		.	.743					
Q25	I ask others for help when I don't understand something				.860				
Q40	. I change strategies when I fail to understand				.770				
Q44	. I re evaluate my assumptions when I get confused.				.760				
Q51	. I stop and go back over new information that is not clear				.742				
Q18	I ask myself if there was an easier way to do things after I finish a task.					.767			
Q7	. I know how well I did once I finish a test.					.757			
Q38	I ask myself if I have considered all options after I have solved a problem					.747			
Q36	. I ask myself how well I accomplish my goals once I'm finished					.737			
Q5	I understand my intellectual strengths and weaknesses						.874		
Q10	I know what kind of information is most important to learn						.764		
Q20	. I have control over how well I learn						.734		
Q14	I have a specific purpose for each strategy use							.891	
Q27	. I am aware of what strategies I use when I study							.771	
Q33	find myself using helpful learning strategies automatically							.762	
Q18	. I use different learning strategies depending on the situation								.782
Q35	I know when each strategy I use will be most effective								.776

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 13 iterations.

Table 3 The Mean, Standard Deviation, Number of Items

FACTORS	NAME OF FACTORS	CRONBACH ALPHA	MEAN	SD	NO. OF ITEMS
1	PLAANNING	.80	35.6	5.7	6
2	MONITORING	.81	27.2	5.2	5
3	INFORMATION MANAGEMENT	.76	23.3	7.0	5
4	DEBBUGING STRATEGY	.81	21.7	5.2	4
5	EVALUATION	.79	20.9	5.6	4
6	DECLARATIVE KNOWLEDGE	.85	14.9	4.6	3
7	PROCEDURAL KNOWLEDGE	.78	16.4	3.6	3
8	CONDITIONAL KNOWLEDGE	.60	10.9	2.7	2

TABLE 4 The result of the model fit statistics (n=1017)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	74	498.688	487	..234	1.024
Saturated model	561	.000	0		
Independence model	33	1173.992	528	.000	78.266

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.962	.959	.966	.970	.965
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.272	.922	.873	.493
Saturated model	.000	1.000		
Independence model	.913	.266	.153	.230

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.040	.053	.090	.871
Independence model	.195	.186	.204	.000

Table 3 shows the names of the factors, their reliabilities, standard deviation and number of items in each factor. Factor one has the highest mean of 35.6 with a standard deviation of 5.7 and factor 8 which is conditional knowledge has a mean of 10.9 and with a standard deviation of 2.7.

The result of table 4 shows the fit statistics from the CFA. The X^2 yield a result of 498.688 (df=487) which is not significant at p > .05 · This indicates that the model fits the data. The values of TLI, CFI, GFI and RMSEA are .970, .966, .922 and .040 respectively which confirm that the model has a good fit.

Table 5 The reliability of the Meta-cognitive awareness scale (n=1017)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.891	.893	32

Table 4 shows the reliability coefficient of the meta-cognitive awareness scale, which is .89. this indicates a high reliability coefficient. Hence the MAS is reliable.

DISCUSSION

The aim of this study was to validate the meta-cognitive Awareness scale to measure secondary school students in other to help them develop their meta-cognition for meaningful learning. The 52 items of the scale were reduced to 32 because of factor loadings. The analysis yielded an eight factor model comprising of meta cognitive knowledge and meta-cognitive regulation. This is in agreement with Akanar & Ergin (2009) who validated the Metacognitve Awareness scale to measure primary school children. The metacognitive knowledge consist of; declarative knowledge, procedural knowledge and conditional knowledge. While the meta-cognitive regulation comprises of; Planning, Monitoring, Information Management, Debugging Strategy and Evaluation. Factor analysis provided an evidence to the reliability and the validity of the scale as shown by the factor loadings which exceeded the suggested values and accounted for 88.7% of the total variance explained by the analysis, and the fit statistics which confirm that the model is a good fit.. The cronbach's alpha internal consistency of the scale which is .89 ib also high. Hence the MAS scale is a reliable and valide measurement scale, fit for the assessment of the secondary school students'

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