ASSESSMENT OF THE METACOGNITIVE AWARENESS AND ITS IMPLICATION ON TECHNICAL COLLEGE STUDENTS'ACADEMIC ACHIVEMENT IN NIGERSTATE

Owodunni Ayanda Samuel,
Igwe, Christopher O
and
Hassan Abdullahi. Muhammad
Department of Industrial and Technology Education
Federal University of Technology, Minna
Niger State
E-mail: owoscosam@yahoo.com

Abstract

This study assessedtechnical students' metacognitive awareness and its implication on their academic achievement in Niger State technical colleges.The study adopted a correlation survey research design. The population of the study was 188 National Technical Certificate (NTC) II technical students. Three research questions and three null hypotheses, tested at 0.05 level of significance, guided the study. The instruments used for data collection wereMetacognitive Awareness Inventory (MAI) and Technical drawing Achievement Test (TDAT). The inventory was validated by experts for use in Nigeria context. The trial test for determining the coefficient of stability of the instrument was carried out using 40students in Government Science Technical College Garki, Abujain the Federal Capital Territory. The reliability coefficient computed for the achievement test was found to be 0.88. Mean was used to answer the research questions.Kendall's Tau-b correlation coefficient was applied for the measurement of correlation among/between the variables of interest, while t-test statistics was employed to test the hypotheses. The study found out that male students performed better than the female students in the achievement test and MAI subscales.The study revealed among others that urban students performed better than rural students in the achievement test and MAI subscales;there was a link among internet usage, library habits, students' metacognition and students' achievement; performance of highly metacognitively aware students was better on the achievement test than lowmetacognitively aware students; there was no significant difference between metacognition of male and female students and between urban and rural students. Consequently, it was recommended among others that the training of students should be focused on where they need support to develop their metacognition and that internet surfing and reading library books have good impact on metacognitive awareness.

Key words: Assessment, Metacognition, Awareness, Achievement, Technical Drawing and Technical Colleges

Introduction

Teachers today are faced with classrooms full of students who come with varying levels of knowledge about how they learn. Some students are active, self directedlearners who know how they learn and are able to apply what they know to various learningsituations. Others may be average students who work hard and who have awareness of theirlearning strengths and weaknesses, but who may not adequately regulate their learning styles. Stillothers may be passive learners who have little

awareness of how they learn and how to regulatetheir learning. In essence, teachersmeet with students with various levels of metacognitive skills.Metacognition refers to a level of thinking that involves active control over the process of thinking that is used in learning situations. It involves planning the way to approach a learning task, monitoring comprehension, and evaluating the progress towards the completion of a task, among others.

Metacognition according to Ormod (2004) is generally defined as the activity of monitoring and controlling one'scognition. It can further be defined as what we know about our cognitive processes and how weuse these processes in order to learn and remember. Researchers furtherconceptualize metacognition by breaking down metacognition into two subcomponents,metacognitive knowledge and metacognitive regulation. These two subcomponents have beentheorized to be related to one another (Brown, 1987; Flavell, 1987; Schraw and Dennison,1994).
Metacognitive knowledge can be described as what a learner knows about his/her own cognitiveprocesses.
Declarative, procedural and conditional knowledge may all be consideredsubcomponents of metacognitive knowledge (Schraw&Moshman, 1995). Jacobs and Paris (1987) also stressed that metacognition includes at least three different types of metacognitive awareness when considering metacognitive knowledge

1. **Declarative Knowledge**: refers to knowledge about oneself as a learner and about what factors can influence one's performance. Declarative knowledge can also be referred to as "world knowledge"(Schraw, 1998;Schneider &Artelt, 2010).Declarative knowledge involves what a learner knows about, how he/she learns and what influences how he/she learns
2. **Procedural Knowledge**: refers to knowledge about doing things. This type of knowledge is displayed as heuristics and strategies (Schraw, 1998). A high degree of procedural knowledge can allow individuals to perform tasks more automatically. This is achieved through a large variety of strategies that can be accessed more efficiently (Pressley,Borkowski& Schneider,1987).Procedural knowledge is the knowledge about different learning and memory strategies/procedures that work best.
3. **Conditional knowledge**: refers to knowing when and why to use declarative and procedural knowledge (Garner, 1990). It allows students to allocate their resources when using strategies. This in turn allows the strategies to become more effective Reynolds, (1992). Conditional knowledge is the knowledge possessed about the conditions under which various cognitive strategies can be implemented.

As a whole, theknowledge of cognition refers to what a leaner knows about, how he or she learn; what he/she knows about theprocedures and strategies that are the most effective for him/her; and what he/she know about theconditions under which various cognitive activities are most effective (Schraw&Moshman,1995).

Metacognitive regulation in contrast to metacognitive knowledge may be thought of asthe actual activities in which the learner engages in order to facilitate learning and

memory (Schraw&Moshman, 1995).Jacobs andParis (1987) classified Metacognitive regulation into three component activities.These include planning, monitoring and evaluating. Planning involves strategising acognitive task by selecting appropriate strategies and cognitive resources.It can also be refers to as the appropriate selection of strategies and the correct allocation of resources that affect task performance. Monitoring involvesthe awareness of progress through a cognitive task and the ability to determine performance. Which is also refers to one's awareness of comprehension and task performance. Finally, evaluating involves taking a look at the outcome and determining if thelearning outcome matches our learning goals and if the regulation processes we used wereeffective. Which can also refers to appraising the final product of a task and the efficiency at which the task was performed. This can include re-evaluating strategies that were used.

It could be reason out that if students have well developed metacognitive knowledge andmetacognitive regulatory skills,the students will excel academically when they use them.Consequently, it is important to be able to assess metacognition of college students to determineif this knowledge and skills are related to academic achievement, and if related, teachers can use various techniques to assess their students' metacognition and develop means by whichthe students can improve on it when necessary.

Students who demonstrate a wide range of metacognitive skills perform better in exams and complete work more efficiently. They are self-regulated learners who utilize the "right tool for the job" and modify learning strategies and skills based on their awareness of effectiveness. Individuals with a high level of metacognitive knowledge and skill identify blocks to learning as early as possible and change "tools" or strategies to ensure goal attainment.

Schraw and Dennison (1994) developed the Metacognitive Awareness Inventory (MAI) to assess metacognitive knowledge and metacognitive regulation which they referred to as the knowledge of cognition factor and the regulation of cognition factor. The MAI consists of 52questions tapping into these two components of metacognition. They found that there was strongsupport for the knowledge of cognition and regulation of cognition components and that these two components were related as had been suggested in the research (Brown, 1987). This study was unique in a sense that findings of the study would be helpful for technical drawing students. Thus the present study has undertaken the task of analysing technology students' metacognition awareness using Schraw and Dennison (1994) Metacognitive Inventory (MAI). The inventory has been adapted for local use. Some students related factors such as gender and location were also taken into account.

Statement of the Problem

The main aim of teaching is to equip students with information and tools that permit them to solve problems objectively. Thus, many students seem usually unable to solve non-school problems or even possess the essential knowledge and tools necessary to do so. This deficiency might be linked to absent or ineffective metacognitive awareness. This situation demands enriching teaching and learning process to inducemetacognitively oriented teaching strategies and create awareness about metacognition.Creating awareness about metacognition can improve classroom

communication and facilitate academic performance. Due to its importance in the process of education, the present study was conducted to assess the metacognitive awareness of technical students by identifying metacognitive activities carried out in the classroom. In addition, the study aimed to measure the metacognition of students.

Purpose of the Study

The study sought to:

1. Determine metacognitive awareness of technical drawing students in technical colleges.
2. Identify factors responsible for different social factors in metacognitive awareness of technical drawing students in technical colleges.
3. Determine the impact of metacognitive awareness on students' academic achievement of students in technical drawingin technical colleges.

Research Questions

1. What isthe metacognitive awareness of students in technical college?
2. What are the factors responsible for different social factors in metacognitive awareness of technical drawing studentsin technical colleges?
3. What is the impact of metacognitive awareness on academic achievement of students in technical drawingin technical colleges?

Hypotheses

HO_1.There is no significant difference between Metacognitive awareness of male and female students in MAI.

HO_2.There is no significant difference between Metacognitive awareness of urban and rural students in MAI

HO_3.There is a significant impact of Metacognitive awareness on academic performance of students in MAI and Technical Drawing

Methodology

This study was a correlation survey design in which metacognitive awareness of technicalstudents were assessed using metacognitive inventory. Impact of students related factors like gender, location, library and internet use were also considered. The population comprised all the NTC IItechnical students from four technical colleges offeringtechnical drawing in Niger State. Four technical colleges were selected. Multistage sampling technique was used. The sample size was determined by using criteria given by Johnson & Christensen (2000). Thus for this study a sample of 102 urban technical students (95 males and 12 females) and 86 rural technical students (77 males and 9 females) were selected randomly from the population.

Researcher adapted Schramand Dennison (1994) metacognitive awareness inventory (MAI) for measuring the metacognitive awareness of students, because it has been tested to be reliable and valid instrument ($r = 0.89$). The inventory was validated by experts for use in Nigeria context. The inventory was also facto analyzed. For adoption of socially and culturally suitable and valid and reliable inventory several efforts were carried out such as:

I. A number of empirical studies on metacognition were reviewed.
ii. Use of expert opinion about items of instruments.
iii. Use of statistical analysis to determine the validity and reliability of the instruments

The inventory represents two factors of metacognition, which are knowledge of cognition and regulation of cognition. Knowledge of cognition or metacognitive knowledge refers to knowledge about self and about learning strategies as well as knowledge about when, why and how to use these strategies.

Within the knowledge component were statements of declarative knowledge (knowledge about self and strategies), procedural knowledge (knowledge about strategy use), and conditional knowledge (when and why to use strategies). The regulation of cognition refers to the control aspect of learning such as planning (goal setting), management strategies (organizing), comprehension monitoring, debugging and evaluation (analysis of performance and strategy effectiveness). The original inventory consisted of 52 items which were group into 6 components as planning, management strategies, evaluation, procedural, conditional and declarative knowledge. The items to these subscales were based on the Schraw and Dennison inventory, with the addition of a few new statements. The procedural knowledge consisted of 4 items, declarative knowledge containing 6 items, and conditional knowledge having 4 items, planning subscale included 5 items, management strategies having 11 items and evaluation subscale having 7 items. Each inventory was a four point scale ranging from "Always" to "Not at all" in which the participants were asked to tick appropriate box. The responses were coded as: Always = 4 Sometimes = 3 Undecided = 2 Not at all = 1

The inventory was validated by five experienced researchers and changes in wording and grammatical structures were incorporated. The instrument was administered on sample of 30 technicalstudents (20 males and 10 females) in Government Technical College Garki Abuja, FCT to determine its reliability. The reliability coefficient of the instrument was found to be 0.88 using Cronbach Alpha formula.

Achievement Test

The researcher developed an achievement test in the technical drawing subject. The test was not only memory-based (35% of items testing memory) but it aimed to test thinking and metacognitive skills (65% of items measuring metacognitive skills) used by the learners in their learning. Test items were based on National Board for Technical Education (NBTE) curriculum for technical colleges. Three indicators were kept in mind while constructing items-the difficulty, understandability and relevance of items to the objectives of the study. The initial form of the test consisted of 50 items. Thus, with the help of advisor and experts, the researcher reviewed statements to find out how well the respondents understood the items being asked. Discussion resulted in the removal and modification of a number of items from the test. It was then pilot tested. After pilot test some difficult items were removed while some items were restructured. For reliability and validity of achievement test, it was administered twice on the same groups on two different occasions. After administration, the difficulty level of achievement test was calculated. The first group of test consisted of 58 item. Items

having high and very low difficulty level were removed. Items having moderate difficulty level were chosen for the study. Some items were reworded and restructured. Correlation coefficients were also computed, items having value of "r" less than 0.4 (Garrett, 2000) were removed. After these processes test ended up with 30 items.

Experimental Procedure

The researcher administered the instruments in the four technical colleges selected with the help of four research assistants. Before administering the instruments, a brief introduction about the research was provided to the subjects. The subjects were asked to read the statements carefully and indicate their response by marking the appropriate box. They were told that there are no right and wrong answers to the statement in the inventories. They were further asked to rate themselves on use of metacognition while learning as accurately and honestly as they could. The inventories were first administered to the subjects followed by the technical drawing achievement test. Average completion time for the metacognitive inventories and achievement test was ten and thirty minutes respectively. Personal information was also collected about each student regarding their gender, use of internet andreading of library books. This information was collected to examine their impact on achievement and metacognitive awareness of students.. Mean, percentage, standard deviation and t-test were used for assessing the metacognitive awareness of students. Kendall's Tau-b correlation coefficient was applied for the measurement of correlation among/between the variables of interest. Hypotheses were tested at .05 alpha level using SPSS version 13.0.

Results

Table 1: t-test Analysis of the mean scores of students by gender and ocation on of metacognitive inventory Sub scales.

Metacognitive Inventory (MAI) Sub scales	Gender						Location					
	Male N = 167		Female N = 21		Statistics		Urban N = 102		Rural N = 86		Statistics	
	$\bar{X}$	SD	$\bar{X}$	SD	t-test	p	$\bar{X}$	SD	$\bar{X}$	SD	t-test	p
Procedural knowledge	46.0	2.50	15.7	1.62	1.60	n.s	37	1.07	15.1	1.48	2.21	p<0.05
Declarative knowledge	33.6	3.60	24.0	3.4	1.30	n.s	34	1.85	23.4	0.99	2.31	p<0.05
Conditional knowledge	45.5	4.60	16.0	5.49	1.40	n.s	42	0.75	39.6	1.17	1.70	n.s
Planning	23.2	3.80	43.08	2.75	1.78	n.s	49	0.89	21.5	0.67	0.65	n.s
Management strategies	18	2.90	34.8	3.33	0.87	n.s	46	0.99	27.0	1.40	0.77	n.s
Evaluation	2.28	3.60	21.0	4.10	2.67	p<0.05	170.87		35.6	1.01	0.89	n.s

Key:

N = number of respondents $\bar{X}$ =Mean

SD = Standard Deviation ns = not significant

Table 1 discloses a comparison of male and female students and urban and rural students for different sub scales of the inventory. The table reveals that male students possessed high mean score on procedural and condition knowledge while female students have high average score on planning. However, the differences, although highly significant, are very small.

The data presented in table 1 also shows that urban students possessed high mean score on management strategies and planning sub scales of the inventory. However, the difference was significant only in the case of procedural and declarative knowledge sub

scale. The table also reveals that urban students possessed high mean score on all sub scales except evaluation sub scale of the inventory.

Table 2: Mean Achievement Scores of Students by Gender and Location

Gender	N	Mean	SD	t-test	P	Location	N	Mean	SD	t-test	P
Male	167	48.50	2.70	8.20	<	Urban	102	40.50	2.30	7.20	<0.001
Female	21	43.43	1.85		0.001	Rural	86	28.43	1.95		

The data presented in table2 revealed significant difference between test score of male and female students. Thus male students performed better than female students on the test. In addition, the table also indicated significant difference between test score of urban and rural students. Thus urban students also performed better than rural students on the test.

Table 3: Mean Achievement and MAI Scores of Students by Internet and Library usage

	Internet usage			Library usage		
Option	N	Mean	MAI	N	Mean	MAI
Not at all	88	24	110	62	26	105
Sometimes	52	32	134	75	31	128
Always	40	45	146	51	44	149

Table 3 revealed that students that always make use of internet and library service performed better than those that sometimes use them in the achievement test and MAI inventory subscales while those that sometimes use the internet and library services performed that better than those that do not use them at all.

Table 4: Correlation between Internet use, Library use, MAI and achievement score of students

Option	Internet use				Library use			
	Mean	Frequency	Percentage	MAI	Mean	Frequency	Percentage	MAI
Not at all	20	88	46.81	110	26	62	32.98	105
Sometime	37	60	31.91	134	31	75	39.89	128
Always	45	40	21.28	146	42	51	27.13	149

It is reported in table 4 that internet use can be correlated with MAI of students ($r = 0.06$, $p < 0.002$) and test score ($r = 0.26$, $p<0.01$) by using Kendall's Tau-b. It is highly likely that those with access to the internet and an interest in using it will be those who are more academically aware.

Library use, MAI and achievement score of students. It is also reported in table 4 that library use can be correlated with MAI of students ($r = 0.07$, $p < 0.001$) and test score ($r = 0.26$, $p<0.01$) by using Kendall's Tau-b. Again, this is entirely unsurprising in that the library is a powerful tool in developing academic skills.

Table 5: Testing of Hypotheses

Hypotheses	Statement	t-test	P	Results
HO_1	There is no significant difference between Metacognitive awareness of male and female Students.	t = 0.05	<0.001	Null hypothesis accepted, there was no significant difference between MAI score of male and female students,
HO_2	There is no significant difference between Metacognitive awareness of urban and rural students.	t = 6.42	< 0.001	Null hypothesis rejected, t he scores in the MAI test of urban students are very much higher than the scores of rural students.
HO_3	There is no significant impact of Metacognitive awareness on academic performance of students in the achievement test	F=10.41	<0.01	Null hypothesis rejected, Performance of highly metacognitively aware students was better on the achievement test than low metacognitively aware students.

Discussion of findings

The results of the study in table 1and 2indicated that male students performed better than the female students in the achievement test and MAI subscales. Similarly, the table further revealed that urban students performed better than rural students in the achievement test and MAI subscales. This finding is in consonance with the findings of Ur-Rehman (2011) who carried out a study on the assessment of Science Teachers Meta-Congitive Awareness and its impact on the performance of students and found out that male students performed better than female students and urban students also performed better than rural students in MAI subscale.

Some others variables also related to metacognitive awareness in table 3 and 4: these included internet use and library habits. It is interesting to mention that the results of the study revealed a link among internet usage, library habits, students' metacognition and students' achievement. This highlights the importance of internet and library usage in enhancing students'metacognition. This finding is in inline with the findings of Ur-Rehman (2011) who found out in his study that the use of library, internet facilities, mother influence and among others enhances students'metacognition. Young and Fry (2008) also stressed that that if students have well developed metacognitive knowledge and metacognitive regulatory skills through the use of libraries and other social media, whenever the students use their metacognition they will excel academically.The results also provided support to previous research on relationshipsbetween metacognition and academic achievement (Schraw & Dennison, 1994; Everson & Tobias, 1998; Young & Fry, 2008). But thishas to be interpreted cautiously. A relationship does not necessarily imply cause andeffect. Thus, it cannot be suggested, from this and previous studies, thatmetacognitive skills aid performance.

Lastly the findings of this study revealed in table 5 that there was no significant difference between metacognition of male and female students. Thus, the present study revealed little significant gender differences in metacognitive awareness. The lack of gender difference is totally unsurprising. However, with students aged about 14 and the known maturity differences at that age, it is somewhat surprising that girls do not outperform the boys in metacognitive awareness. There was significant difference difference between metacognition of urban and rural students (Ur-Rehman, 2011). This may be due to the facts that rural students may have disadvantages, perhaps arising from fewer resources at home and at school. The study also revealed from table 5 that performance of highly metacognitively aware students was better on the test than low metacognitively aware students.

Conclusions

The factor analyses showed clearly that metacognition is not a single variable. This is a most important finding. It can be seen that metacognition is a highly complex collation of many aspects of awareness related to the whole process of teaching and learning. The suggestion that it can be conceptualized into six variables was also not supported by this study. This means that future research is much need to tease out the complexities of the notion of metacognition.Looking at the students themselves, urban and rural students differed in their MAI and test scores while the mean score of male students was higher than female students on the technical drawing test.

Recommendations

The following were the main recommendations of the study:

1. The training of the students should be focused on the areas that can enhance their metacognitive development. These areas include:
   - Self awareness about intellectual strengths and weaknesses
   - Awareness about learners' expectations
   - Help in thinking strategies
   - Memory training and organizing time
   - Learning strategies.
2. The students should be encouraged to use internet surfing and read library books that enhance metacognitive development.
3. The teacher should create awareness in students about thinking process and encourage the students to think about learning for self regulation.

References

Brown, A. (1987). *Metacogntion, executive control, self-regulation, and other more mysterious mechanisms.* In F. Weinert and R. Kluwe (Eds.), Metacognition, motivation and understanding (pp. 65-116). Hillsdale, NJ: Erlbaum.

Everson, H. T. and Tobias, S. (1998). The ability to estimate knowledge and performance in college: A metacognitive analysis. Instructional Science, 26, 65-79.

Flavell, J.H. (1987). Speculations about the nature and development of metacognition. In F. Weinert and

Flavell, J.H. (1979). "Metacognition and cognitive monitoring. A new area of cognitive-development inquiry". *American Psychologist,* 34: 906–911.

Garner, R (1990). "When children and adults do not use learning strategies: Toward a theory of settings". *Review of Educational Research,* 60: 517–529.

Hartman, H. E. (2001). *Metacognition in learning and instruction:* Theory, research and practice. Netherland: Kluwer Academic.

Jacobs, J.E.; Paris, S.G. (1987). "Children's metacognition about reading: Issues in definition, measurement, and instruction". *Educational Psychologist* 22,225–278.

Johnson, B., & Chistensen, L. (2000). *Educational research: quantitative and qualitative approaches.* Needam Heights, MA: Allyn & Bacon.

Ormrod, J.E. (2004). *Human Learning. Upper Saddle River,* NJ: Pearson Prentice Hall.

Pressley, M; Borkowski, J.G. & Schneider, W. (1987). "Cognitive strategies: Good strategy users coordinate metacognition and knowledge". *Annals of Child Development* 5.

Reynolds, R.E. (1992). "Selective attention and prose learning: Theoretical and empirical research". *Educational Psychology Review,* 4: 345–391.

Schneider, W; Artelt, C. (2010). "Metacognition and mathematics education". *ZDM Mathematics Education,* 42 (2): 149.

Schraw, G. (1994). The effect of knowledge on local and global monitoring. *Contemporary Educational Psychology,* 19, 143-154.

Schraw, G. and Moshman, D. (1995). Metacognitive Theories. *Educational Psychology Review,* 7(4), 351-371.

Schraw, G. and Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology,* 19, 460-475.

Schraw, Gregory (1998). "Promoting general metacognitive awareness". *Instructional Science,* 26: 113–125.

Swanson, H.L. (1990). "Influence of metacognitive knowledge and aptitude on problem solving". *Journal of Educational Psychology,* 82: 306–314.

Ur-Rehman, F. (2011) Assessment of Science Teachers Meta-Congitive Awareness and its impact on the performance of students. PhD thesis, Allama Iqbal Open University, Islamabad

Young, A & Fry, D. J. (2008) Metacognitive awareness and academic achievement in college Students. *Journal of the Scholarship of Teaching and Learning,* Vol. 8, No. 2pp. 1-10.