

An Assessment of the Level and Patterns of Metacognition among Dental Students in a Northwestern Nigerian University

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ABSTRACT

Objective: Metacognition is a recognized means of self-motivation, and may be measured by the use of the Metacognitive Awareness Index (MAI). This study sought to perform a situational analysis of the levels of metacognitive awareness among dental students at the University and relate this to selected socio-demographic factors to aid student mentoring.

Methods: The MAI questionnaire and eleven questions retrieving selected sociodemographic data were electronically administered on consenting dental students of the University. Retrieved data was entered into a spreadsheet and analyzed with IBM SPSS Statistics (version 23). Frequencies were recorded, means were generated and compared by cross-tabulation. The level of significance was set at $p < 0.05$.

Results: 81.9% of the student population participated in the study. There were 68 (60.2%) males and 45 (39.8%) females. 14 (12.4%) of the cohort were married. The mean MAI score was 42.2 (81.2%) with a standard deviation of 8.5 (16.3%). The best performances were recorded for de-bugging strategies 92.0% (22.0%), while declarative knowledge recorded the worst performances 71.3% (22.5%).

Males outperformed females without statistical significance ($p = 0.066$) and married students were strongly outperformed by their unmarried counterparts ($p = 0.000$). The first year and final year students performed better than students from the other classes ($p = 0.045$). The MAI scores increased with increasing age ($p = 0.023$), while the accommodation of the students did not impact their scores ($p = 0.317$).

Conclusion: The level of metacognitive awareness recorded was very good. However, mentors should pay particular attention to married students and students outside the first and final year classes

Keywords: Metacognition, Metacognitive awareness, Motivation, Mentoring

INTRODUCTION

Student mentoring and counselling are increasingly gaining importance in undergraduate education (Elliot et al., 2009; Crisp et al., 2017). This increased emphasis on mentoring seems to find universal acceptance among trainers (Crisp et al., 2017).

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The methods adopted for mentoring students may however vary among mentors (Crisp et al., 2017). A

common thread that runs through the mentoring process in contemporary times is the increasing awareness of the role of the learner's self-motivation in the learning process (Efkilides, 2009; Barbosa et al., 2016). The mentoring process can be made more scientific by acquiring and analyzing data related to the learner's motivation from the learners themselves.

One of the earliest techniques used to encourage self-motivation among students was the Socratic method developed in ancient Greece (Tanner, 2012; Dinkins & Cangelosi, 2019). Socrates encouraged his students to ask themselves questions about the knowledge they acquired (Dinkins & Cangelosi, 2019). Some investigators in the earlier parts of the twentieth century even asserted that we learn more from reflecting on our experiences than from the experiences themselves (Tanner, 2012). This concept of reflecting on knowledge has developed into the modern concept of metacognition (Saber et al., 2017).

Metacognition is a term coined by Flavell in 1976 (Moritz and Lysaker, 2018). It may be defined as an awareness or analysis of one's learning or thinking processes (Tanner, 2012). It derives from the root words "meta" and "cognition" and roughly translates to "beyond thinking" or "knowing about knowing" (Zhao et al., 2014). It is said to have developed from neo-Piagetian concepts of cognitive development (Fox & Riconscente, 2008). The concept encompasses within itself some elements of critical thinking and planning (Tanner 2012).

Metacognition can be said to have two components. Each of these components also have sub-components. The two basic components of metacognition are metacognitive knowledge and metacognitive regulation (Schraw & Dennison, 1994; Tanner, 2012). The emotions that follow the metacognitive process is often referred to as a metacognitive experience (Jia et al., 2019). Metacognitive knowledge can be said to consist of declarative-knowledge, procedural-knowledge and conditional-knowledge. While declarative knowledge is knowledge about self, procedural knowledge refers to knowledge about methods that enable the learner to learn things about themselves. Conditional knowledge refers to the knowledge of knowing which type of knowledge to employ (Schraw & Dennison, 1994).

Metacognitive regulation consists of five skills - planning, comprehension monitoring, evaluation, information management and debugging. Planning refers to the selection of strategies based on the awareness generated from metacognitive knowledge. Monitoring refers to awareness of the

progression of task performance, while evaluation refers to an appraisal of the quality and efficiency of the performance of the task. Planning involves sequencing such skills as organizing, elaborating and summarizing information. It may also involve selective focusing on certain parts of a large piece of information, often referred to as information management. The monitoring process may necessitate a re-strategizing called debugging (Schraw & Dennison, 1994).

The work of the committee of educators chaired by Benjamin Bloom in the early 1950s recognized three distinct domains of learning (Kasilingam et al., 2014). These domains are the cognitive, affective and sensory domains. Traditionally, higher education has placed more emphasis on cognitive development than other domains. However, in a field like dentistry, the affective and sensory domains are just as important as cognitive activity. Positive emotional experiences have been associated with improved academic performances when socio-economic factors have been controlled for (Hascher, 2010).

Socio-economic factors are strongly correlated with emotional and mental health (Jakoby, 2016). The ease of access to lecture rooms, ease of payment of fees and other sundry issues directly affect a student's capacity to learn in a developing country like Nigeria. The marital status of the student could also be a big factor in determining the socio-economic status of the student.

Intellectual ability may intuitively seem to be a predictor of academic performance in the University. The scores on the University Matriculation examinations (UTME) may be used as an objective assessment of intellectual ability of the students at admission. However, the available evidence suggests that while ability has a good predictive value initially, personality traits and motivational variables (metacognition is a form of personal motivation) are now thought to have more predictive value of academic performance in the university (Pelaccia & Viau, 2017; Medina, et al., 2017).

The language of instruction has been shown to have some effect on the academic performance of students (Komba & Bosco, 2015). The language of instruction in Nigerian Universities is the English Language. All matriculated students must have achieved a minimum score in English at the SSCE, but the language may still constitute a challenge. It would be interesting to know if difficulties with the language of instruction may affect metacognition among a Nigerian student population.

There are different methods of measuring metacognition. However, a comprehensive

instrument has been designed for its assessment. This instrument is ascribed to Schraw and Dennison and is known as The Metacognitive Awareness Inventory (Schraw and Dennison, 1994). It is a 52 true or false question questionnaire. A true response is scored as 1 and a false response is scored as 0. The scores are summed together to give a score for the metacognitive awareness for the respondent. The instrument also has a key attached that may be used to score the different components of metacognition i.e. metacognitive knowledge and metacognitive regulation with their individual subdivisions.

The study sought to assess metacognitive awareness among dental students of the Bayero University Kano with the Metacognitive Awareness Inventory and compare this to selected socio-demographic factors. This comparison will serve as a guide to mentors in maximizing introspection and motivation among dental students during their course of study.

MATERIALS AND METHODS

Ethical approval was sought and obtained from the Ethics Review Board of Aminu Kano Teaching Hospital (NHREC/28/01/2020/AKTH/EC/2865). The study was a cross-sectional observational study among dental students. A sample size of 102 from a population of 138 students was determined at 95% confidence level, 5% margin of error and 50% population proportion. The sample size was determined using the sample size calculator from www.calculator.net. The Metacognitive Awareness Inventory along with an 11-item questionnaire (Appendix B) was administered in the months of September and October 2020 on willing participants among the students of the Faculty of Dentistry, Bayero University; Kano. The questionnaire retrieved data on biodata and socio-demographic indices considered to be relevant to the learning process by the investigators. The instruments were administered electronically by the use of the Survey-Monkey application. Data

was retrieved on an Excel spreadsheet and entered into IBM SPSS Statistics version 23 for analysis. Frequencies were computed, means determined and compared by cross tabulation. The level of significance was set at $p < 0.05$.

RESULTS

A total of 113 out of 138 students (81.9% of the student population) participated in the study. There were 68 males (60.2%) and 45 females (39.8%). There were 14 (12.4%) married respondents compared to 99 (87.6%) single respondents. There were 5 males (35.7%) and 9 females (64.3%) among the married respondents. Twenty-five respondents (22.1%) reported having difficulty with the language of instruction compared with 88 (77.9%) who did not. Fifty-two students (46%) had a daily plan for personal study, while 8 (7.1%) studied only during weekends. Thirteen students (11.5%) studied mainly before examinations, while 40 students (35.4%) had no particular pattern for personal study. Fifty-eight students (51.3%) lived on campus while 55 (48.7%) lived off campus.

The mean Metacognitive Awareness Inventory (MAI) score was 42.2 (81.2%) with a standard deviation of 8.5 (16.3%). The MAI scores were graded as 0 – 9 (0% - 17.3%) very poor, 10 – 19 (19.2% - 36.5%): poor, 20 – 29 (38.5% - 55.8%): fair, 30 – 39 (57.7% - 75.0%): good, 40 – 49 (76.9% - 94.2%): very good and 50 – 52 (96.2% - 100.0%): excellent. The frequency of MAI scores arranged as grades from very poor to excellent is shown in Table 1. The mean scores for each of the components of the MAI are as follows: Declarative knowledge [5.7 (1.8) 71.3% (22.5%)]. Conditional knowledge [4.2 (1.1) 84.0% (22.5%)], Procedural knowledge [3.3 (0.9) 83.5% (22.5%)], Planning [5.5 (1.5) 78.6% (21.4%)], Information management systems [8.1 (2.0) 81.0% (20.0%)], Comprehension monitoring [5.9 (1.4) 84.3% (20.0%)], Debugging strategies [4.6 (1.10) 92.0% (22.0%) and Evaluation [4.8 (1.4) 80.0% (23.3%)].

Table 1: Frequency of MAI scores

Score range	Frequency	%
Very poor	1	0.9
Poor	3	2.7
Fair	1	0.9
Good	26	23.0
Very good	65	57.5
Excellent	17	15.0
Total	113	100.0

Table 2: MAI scores and gender

Gender	Total metacognitive score range						Total (%)
	Very poor	Poor	Fair	Good	Very good	Excellent	
Male	0	0	1	15	38	14	68 (60.2)
Female	1	3	0	11	27	3	45 (39.8)
Total	1	3	1	26	65	17	113(100)

χ^2 : 10.342, df: 5, $p=0.066$

A comparison of means between the 3 subunits of metacognitive knowledge revealed strong associations between the three subunits ($p=0.000$). There were also strong associations between the mean scores of the 5 subunits of metacognitive regulation. There were strong associations between all knowledge and regulation subunits ($p=0.000$)

The number of females with lower ranges of MAI scores were more than males. This difference did not show statistical significance (Table 2). The MAI scores were highest in the first and final year of study (Table 3). The married participants performed significantly less than their unmarried colleagues (Table 4).

The participants whose studies were funded by their parents had lower MAI scores than those who were either self-funded or who had some form of community sponsorship. Eighty-one (71.7%) of the participants had parental funding of their studies with 1 very poor score, 3 poor scores, 1 fair score and 24 good scores. Forty-six had very good scores, while 6 performed excellently. Twenty-one (18.6%) were self-funded with 1 having a good score and 10 having excellent scores. Four (3.5%) were sponsored by their extended families with 3

registering a good score and 1 being excellent. Seven (6.2%) of the students had scholarships of which 1 had a good score, while 6 recorded very good scores. The relationship of participant age to MAI scores is shown in Table 5.

Ninety-four (83.2%) of participants gained admission through the UTME, while 19 (16.8%) gained admission via A' Levels (Direct Entry). 28 (29.8%) of the UTME admitted participants just managed to meet the admission cut off mark. They had MAI scores as follows: 1 fair, 5 good, and 18 very good along with 4 excellent scores. 65(69.2%) had UTME scores well above the cut off mark with MAI scores as follows: 19 good, 37 very good and 9 excellent. One (0.8%) of the UTME admitted participant had an exceptional entry mark and excellent MAI score. The direct entry participants had 1 very poor, 3 poor, 2 good; 10 very good and 3 excellent MAI scores.

Fifty-eight (51.3%) lived within campus with MAI scores: 14 good, 36 very good and 8 excellent. 55 (48.7%) lived off campus with scores: 1 very poor, 3 poor, 1 fair, 12 good and 29 very good; with 9 excellent scores. The relationship between MAI scores and personal study patterns of the participants is shown in Table 6.

Table 3: MAI scores and level of study

Level of Study	Total Metacognitive Score Range						Total (%)
	Very Poor	Poor	Fair	Good	Very Good	Excellent	
100 Level	0	0	0	3	10	2	15 (13.3)
200 Level	0	1	0	5	11	4	21 (18.6)
300 Level	0	1	0	7	4	0	12 (10.6)
400 Level	1	0	1	4	6	1	13 (11.5)
500 Level	0	1	0	7	20	4	32 (28.3)
600 Level	0	0	0	0	14	6	20 (17.7)
Total	1	3	1	26	65	17	113 (100.0)

χ^2 : 38.170, df: 25, $p=0.045$

Table 4: MAI score and marital status

Marital status	Total metacognitive score range						Total
	Very poor	Poor	Fair	Good	Very good	Excellent	
Single	0	0	1	26	59	13	99
Married	1	3	0	0	6	4	14
Total	1	3	1	26	65	17	113

χ^2 : 34.645, df: 5, $p=0.000$

Table 5: MAI scores and age at admission

Age range at admission (years)	Total metacognitive score range						Total
	Very poor	Poor	Fair	Good	Very good	Excellent	
16 – 20	1	3	0	22	51	6	83
21 – 25	0	0	1	4	13	9	27
26 – 30	0	0	0	0	0	2	2
31 – 35	0	0	0	0	1	0	1
Total	1	3	1	26	65	17	113

χ^2 : 27.767, df: 15, $p=0.023$

Table 6: MAI and pattern of personal study

Accommodation Type	Total metacognitive score range						Total
	Very poor	Poor	Fair	Good	Very good	Excellent	
within campus	0	0	0	14	36	8	58
outside campus	1	3	1	12	29	9	55
Total	1	3	1	26	65	17	113

χ^2 : 5.891, df: 15, $p=0.317$

DISCUSSION

The Senate of the Bayero University, Kano being fully aware of the role of counselling and mentoring in the academic development of her undergraduate students instituted the office of Level coordinators. These are faculty members that are put in a supervisory capacity for each level of study across all the courses of study in the University. These officers also have administrative responsibilities towards the students under their care. They are responsible for these students until the students graduate from the institution. The students are also encouraged to find mentorship amongst the faculty in their own individual capacities.

The current paradigm in medical and dental education is to encourage reflection within the learners for improved performance (Hargreaves, 2016; Sukor et al., 2017). This process is intricately linked with the emphasis on increased personal motivation on the part of the students. The mentors and academic counsellors will play a big part in achieving these ends. The closer nature of the relationship between mentor and mentee allows a greater amount of information exchange between them and hence presents the mentor with a unique opportunity to guide and improve self-motivation among mentees (Ssemata et al., 2017; Hernandez et al., 2017)

Metacognition is one of the ways in which students may motivate themselves toward increased performance (Tanner 2012). An understanding of the prevalent metacognitive abilities and the patterns of its expression among students in a faculty will provide mentors, counsellors and even teachers with a valuable tool to understand the peculiarities of their students and provide them with a scientific basis for planning improvements in

student performance by increasing their motivation. The Metacognition Awareness Index is a good instrument for generating such information. The results from this study show strong associations between all subunits of metacognition measured. We have therefore used the mean MAI scores to characterize our study population.

We have tried to characterize our students based on criteria which we believe will aid in understanding how metacognitive ability is influenced by socio-economic and cultural variables. We have also tried to see how academic achievements at admission may contribute to metacognitive ability among the cohort we studied.

The mean MAI in our study population was higher than that obtained in a similar study in Ibadan, albeit with a greater spread of performance (Anumudu et al., 2019). Most of the participants performed in the 'very good' range. Generally, most participants had scores that showed a good level of metacognitive awareness. The scores for the different components of the awareness questionnaire were all averagely above 70%.

We did not observe a statistically significant difference in the performances between the genders, but we did notice that the performances were significantly different when marital status is considered. This difference is largely due to responses from married women. This may be due to the increased level of responsibility borne by this group of students. The region is essentially patriarchal and polygamous. These cultural challenges may affect the ability of married female students to motivate themselves with regards to their studies. This may make it necessary for mentors and counsellors to pay special attention to

this group of individuals. It may also be prudent to ensure that these group of students are mentored by female members of faculty.

The respondents showed peak performance in the final year of study and performed at a high level in the first year. The intervening years of study had a lower awareness index than these two years, and this difference was statistically significant. This pattern suggests that motivation among students seems to be highest due to the euphoria of gaining admission into, and exiting the program. There should be concerted efforts by the Faculty to increase the outreach to the students at this period. The course content should also be made more stimulating for the students. The students in the 4th year (400 level) had the worst performance overall. This may be related to the shift from pre-clinical to clinical stages of study. This represents a period where more will be required of counsellors. Rigorous teaching of metacognitive techniques at this period may represent a key component to student motivation.

The level of responsibility that socio-economic considerations place on the students was associated with better performance in the test. Self-sponsored students performed better than those sponsored by their parents and increasing age at admission was associated with better performance. This is ordinarily to be expected. However, the students who enjoy parental sponsorship may have been expected to perform better. This expectation would have been understandable in the light of the reduced uncertainty it would engender.

The level of achievement on admission showed an association between increased metacognitive awareness and academic performance. However, it was interesting to observe that direct entry candidates performed significantly less than those who gained admission at ordinary level. This observation suggests to us that the secondary school level performances were a product of the level of metacognitive awareness and those who had to resort to advanced level admission were those who already had a low metacognitive awareness, but were still determined to attend University. Direct entry students in the faculty should be given special attention by their counsellors.

The type of accommodation available to the students and their periods of personal study did not seem to affect metacognitive performance. The language of instruction did not also seem to affect metacognitive awareness. The lack of effect of language on metacognition may validate the quality of the secondary school level English

education. However, the presence of some participants with difficulty calls for vigilance from the faculty.

CONCLUSION

Metacognition can be assessed with the Metacognitive Awareness Inventory. Relating student performance on this inventory with socio-economic characteristics of the student may be used in mentoring the students to improve their personal motivation. Trainers should make themselves familiar with the metacognitive abilities of their students so as to enhance self-motivation among the greatest number of students available to them at any given period.

The students assessed in this study had very good levels of metacognitive abilities. However, special attention should be paid by mentors to married students and students who are not in the entry or exit classes.

RECOMMENDATIONS

University faculties should regularly conduct Metacognitive Awareness Inventories for their students and use data generated from such exercises in counselling students and planning their programs of study.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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