

**Interlinking Metacognition with University Students' Academic Achievements in
Khyber Pakhtunkhwa, Pakistan**

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Abstract

This study aims at investigating the association between metacognitive awareness and student's academic achievements. The study undertakes the objectives and hypotheses on Low, Average and High achievers in addition to assess the effects of metacognition awareness level on student's academic achievement. Through multistage stratified random sampling, data was collected from 160 undergraduate students, studying in Department of Mathematics & Department of English in Abdul Wali Khan University, Khyber Pukhtunkwa. Data was collected through Metacognitive Awareness Inventory (MAI) by Schraw and Dennison (1994), CGPA of the students, and self-developed objective type subject test. Descriptive Statistics & statistical tests (Chi-square & Linear Regression) were applied for data analyses. The results showed that metacognitive awareness had significant effect on student's academic achievement (CGPA) in Department of English whereas it was found to be insignificant in Department of Mathematics. The study recommends an introductory course on Educational Psychology, which cater the metacognitive needs of the students. Moreover, research studies are recommended in the subjects except English and Mathematics. The cultural difference of the students, teachers, and locality of the universities might be taken care of future perspective of researchers.

Keywords: Academic Achievement, MAI, Metacognitive Awareness, Undergraduate Students

Introduction

Learning is a continuous, rather complicated & cyclic process which plays important role in academic development of learners (Dweck, 2002). Metacognition is a new emerging concept, which enable the learner to be smart worker, not hard worker. Flavell in 1976 introduce a term meta-memory, which provided base for the introduction of metacognition in educational psychology (Baltaciand & Akpinar 2011; Kayashima et al., 2004; Yore & Treagust, 2006). Metacognition is further elaborated as know how about mental processes for learning & regulation of mental processes (Brown, 1987). It is the capability through which students implicate cognitive processes in thinking & understanding about and regulating their cognitive processes for the learning processes (Schraw & Dennison, 1994; Sungur & Senler, 2009).

Meta-Cognition can be explained as the knowledge about selection of appropriate strategies for solving problems and fruitful learning. It actually gives information about when, how, why to use any strategy for performing any learning task (Santrock, 2008).

It is generally assumed that students are not using metacognition consciously in their academic as well as general tasks because metacognition is neither taught nor openly discussed concept in the educational context in Pakistan. Metacognition enables the learner to be expert of their own cognitive processes (evaluate, observe, monitor & regulate), which are important for learning. It simply means that how, why and when they understand a concept as well as don't understand a concept. According to research studies, significant association is found among Metacognition, intelligence, and academic achievements (Bağçeci et al., 2011; Young & Fry, 2008; Dunning et al., 2003; Desoete & Roeyers, 2002; Kruger & Dunning, 1999; Borkowski, Carr, & Pressely, 1987; Sternberg, 1986a; Sternberg, 1984). Meta-cognition is important process for in-depth involvement of students in the learning process (Costa & Kellick, 2009). Highly strategic, Problem solver and good

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predictors of own scores are those learners who are highly metacognitive aware (Artzt & Thomas, 1992; Garner & Alexander, 1989; Swanson, 1992). Researchers suggest metacognition as important component for fruitful learning and high academic achievement (Coutinho, 2007; Flavell, 1985; Taebee et al., 1998; Zimmerman, 1990).

Awarded degrees after completion and Cumulative Grade Point Average (CGPA) are mostly representative of academic achievements of individual student. In the current study, the Grade Point Average (GPA) of individual students in previously completed semester's results were considered their academic achievements. The Govt. of Pakistan has focused on higher education and particularly in the province of Khyber Pakhtunkhwa over the last two decades, and to enhance the outcomes of higher education, 29 public sector universities have been instituted in the province of Khyber Pakhtunkhwa as per mentioned phases: before year 2000, from 2000 to 2009, & from 2009 to 2018. A total of nineteen (19) state-owned universities were established in the 3rd phase. Abdul Wali Khan University Mardan (AWKUM) is the only university in 3rd phase, which mothered five universities in the province. Therefore, it is considered that the academic parameters in this university will be more up to date than others. Hence, the present study explains understanding of metacognition among the students in the chosen subjects of Mathematics and English. Metacognition in these two areas is most effective process for best learning (Benito, 2000; Ceylan, & Harputlu, 2015; Karbalaei, 2011; Schoenfeld, 2009; Wenden, 1998) but above cited reports were content limited mostly in the relevant subjects. Our study co-relates the general awareness of metacognition versus academic achievements of students & investigates its effects on student's academic achievements, with special focus on Low, Average, and High achievers, in the selected teaching departments in AWKUM. For one, the following objectives have been developed to answer the effects of Meta-Cognition on students' academic achievement:

Objectives of the Study

- To assess Meta-Cognitive Awareness level of undergraduate students.
- To investigate the effects of Meta-Cognitive Awareness level on students' academic achievement.
- To find association between Meta-Cognitive Awareness level and students' gender.
- To find association between Meta-Cognitive Awareness level and High, Average and Low achievers.

Hypotheses

- There is relationship between Meta-Cognitive Awareness level and academic achievements of students.
- There is difference in Meta-Cognitive Awareness level of female and male students.
- There is difference in Meta-Cognitive Awareness level of High, Average and Low achievers.

METHODOLOGY

Nature and Population of the Study

It is a quantitative study that consists of collection, analysis and interpretation of data regarding metacognitive awareness & student's academic achievements affected by this awareness. "Population is the larger group of which the researcher would like the results to be generalized" (Lodico et al., 2006: p. 13). The target population is Bachelor of Science (BS) students of English & Mathematics departments of AWKUM in four ongoing semesters consisting of 450 & 390 students respectively.

Sample and Sampling Technique

For selection of sample multistage stratified random sampling was used. The selection of AWKUM in first stage of sampling in our study and then specifying Department of English & Mathematics of AWKUM, were because these are effective for conducting researches on metacognition as explained in the literature. The bachelor of studies (BS) students in the departments of English and Mathematics were selected in third-stage of sampling. In both Bachelor program, four semesters were carried on simultaneously i.e., 1st, 2nd, 3rd, & 4th; where, equal allocation of 20 students (10 males, and 10 females) were selected randomly in each semester. The selected students were further divided in to Low, Average, High achievers in forth stage of sampling. In each teaching department i.e., English & Mathematics, eighty students (20 from each semester) were selected. The detail of the sample is also given (Table-1).

Table-1: Sampling Procedure

Sampled Departments	Numbers of Students (Both genders)				Total
	Semester-2	Semester-4	Semester -6	Semester-8	
English	20	20	20	20	80
Mathematics	20	20	20	20	80
Total	40	40	40	40	160

Research Instruments

After a detail study of some important inventories; Awareness of Independent Learning Inventory (AILI); Motivated Strategies for Learning Questionnaire (MSLQ), Metacognitive Awareness Inventory (MAI) developed by Schraw & Dennison in 1994 is adopted by researchers as it is relevant to the essence of present study. It provided reliable assessment of Metacognitive Awareness (Schraw & Dennison, 1994). MAI has two major sub-areas: Metacognitive Knowledge, and Metacognitive Self-regulation. The umbrella of Metacognitive Knowledge covers three minor sub-types namely Conditional Knowledge, Declarative Knowledge, and Procedural Knowledge; whereas, Metacognitive Self-regulation covers five minor sub-types namely Debugging Strategies, Evaluation, Information Management Strategies, Monitoring, and Planning. The MAI for Metacognitive knowledge possessed seventeen items (out of which five, eight and four are for Conditional Knowledge, Declarative Knowledge and Procedural Knowledge respectively). While Metacognitive Self-regulation of MAI comprised of thirty-five items (out of which five, six, ten, seven, seven for subtypes Debugging Strategies, Evaluation, Information Management Strategies, Monitoring, and Planning respectively). Binary choices are given for analysing MAI: Each response was scored 1 and 2 according to true and false, that was further reflected as total score. The data for 52 items of Metacognitive Awareness Inventory is shown in Tables 2 and 3.

Self-Structured Objective Type Test

A total of eight objective type subject tests of 20 MCQs were made for each ongoing semester in both the departments by the teaching faculty. Three cut off values were used to categorize students' performance as Low, Average and High achievers. The cut off value for abovementioned categories is considered <10, between 10 - 15, and > 15 marks. Semester system grading (< 50%, 50%-75% and ≥75%) provide basis for the cut off values. Tests were administered on both departments' sampled students. The attained scores and CGPA/GPA was utilized for establishing the association of MAI.

Academic Achievement

In current study, Student's previous semester/s results is taken as academic achievement of students in form of C/GPA. On the scale of 4 GPA; < 2.5, 2.5-3.5 and ≥ 3.5 are the cutoff values of Low, Average and High achievers. With the C/GPA and MAI scores the obtained results of self-developed tests were compared. Finally, findings and conclusions were drawn after analyzing data via Chi-square and regression.

Data Collection and Analyses

The descriptive statistics, linear regression and chi-square were used for analyses of our data. Descriptive statistics include percentage and frequency methods., linear regression was used for finding the effects of MAI on pupils' academic achievements, whereas, Chi square test was used for finding the association between pupils' academic achievement and MAI.

Results and Findings

Results and finding reviews the descriptive analyses of obtained data from Metacognitive Awareness Inventory (MAI) and regression analyses. In this section, the following results are discussed:

- Metacognition vs. Low, Average High and achiever
- Metacognition vs test score
- Regression Analyses

Table-2: Metacognition Vs Low (L), Average (A) and High (H) Achievers

Components of MAI	N	Department of English Chi square value	Department of Mathematics Chi square value
L, A & H achievers Vs PK	80	0.00	0.921
L, A & H achievers Vs DK	80	0.023	0.941

L, A & H achievers	80		0.95
Vs	80	0.679	
CK			
L, A & H achievers	80		0.941
Vs	80	0.001	
IMS			
L, A & H achievers	80		0.778
Vs	80	0.003	
DS			
L, A & H achievers	80		0.783
Vs	80	0.004	
P			
L, A & H achievers	80		0.98
Vs	80	.409	
M			
L, A & H achievers	80		0.880
Vs	80	0.004	
E			

Data presented in Table-2 elicit that significant association was found between 06 components of metacognitive awareness inventory (Procedural Knowledge (PK), Declarative Knowledge (DK), Information Management Strategies (IMS), Debugging Strategies (DS), Planning (P) and Evaluation (E) and Low, Average and High achievers. While in case of remaining two components; Conditional Knowledge (CK) & Monitoring (M) no significant association was found. In addition, no association was found between metacognitive awareness inventory and Low, Average and High achievers. The hypothesis, “There is difference in Metacognitive awareness level of Low, Average and High achievers” is hereby accepted for sampled students in the departments of English and rejected for the sampled students in the department of Mathematics.

Table-3: Metacognition Vs Test Score (TS)

Components of MAI	N	Department of English Chi square value	Department of Mathematics Chi square value
TS Vs PK	40 40	0.001	0.647
TS Vs DK	40 40	0.02	0.054
TS Vs CK	40 40	0.679	0.499
Test score Vs IMS	40 40	.0008	0.348
TS Vs DS	40 40	0.123	0.348
TS Vs P	40 40	.121	0.404
TS Vs M	40 40	0.464	0.464
TS Vs E	40 40	.005	0.732

The data presented in Table-3 reveal significant association between test score and 06 components of metacognitive awareness inventory; Procedural Knowledge (PK), Declarative Knowledge (DK), Information Management Strategies (IMS), and Evaluation(E). While in case of remaining components (Conditional Knowledge (CK), Debugging Strategies (DS), Planning(P), Monitoring (M) no association was found; while in case of department of Mathematics association is found only for declarative knowledge (DK). The hypotheses “There is relationship between level of

awareness of metacognition and students' academic achievements' 'is hereby accepted for significant chi-square values and rejected for insignificant chi-square values in both the teaching departments.

Regression Analysis (Department of English and Department of Mathematics)

Following are the regression analyses for the independent variable (MAI) and dependent variable (C/GPA) of the sampled students in the department of English and Department of Mathematics.

Table-4: Department of English

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
(constant)	1.816	.287	6.321	.000
PK	.163	.074	2.190	.032
DK	.040	.059	.671	.504
CK	-.092	.051	-1.783	.079
IMS	-.027	.041	-.676	.501
DS	.023	.057	.395	.694
P	.040	.052	.760	.450
M	.114	.069	1.641	.105
E	.080	.075	1.066	.290

The data in Table-4 displays the effect of various MAI strategies on the C/GPA of the students in Department of English. The *constant* here is 1.816 which represent the possible increase in C/GPA even if students did not use any of the minor subtypes of MAI. Similarly, B in the above table shows the increase or decrease in C/GPA per unit in the response to other sub sections. To this effect, if a student is fully aware of Procedural Knowledge (PK) and Declarative Knowledge (DK), the boost in his/her C/GPA is 0.163 and 0.040, respectively. While in case of Conditional Knowledge (CK) -.092 decrease and in case of Information Management Strategies (IMS) -0.027 loses is found in C/GPA of students. The fruitful result of the awareness of Debugging Strategies (DS), Planning (P), Monitoring (M) and Evaluation (E) is in form of 0.023., 0.040, 0.114 and 0.080 enrichment in (C/GPA) respectively.

Table-5: Department of Mathematics

Sub-Types of MAI.	Un-standardized Co-efficient		T	Sig.
	B	Std. Error		
(constant)	2.397	.806	2.972	.004
PK	.235	.302	.777	.440
DK	-.221	.197	-1.125	.264
CK	.430	.334	1.288	.202
IMS Strategies	.045	.105	.426	.671
DS	.101	.124	.813	.419
P	.118	.075	1.575	.120
M	-.133	.161	-.827	.411
E	-.225	.194	-1.160	.250

The data in Table-5 elicits the effect of diverse MAI strategies on the previous semester's C/GPA of the Mathematics students in the department. In this test the *constant* is (2.397). The data exhibited that full application of subtypes of Conditional Knowledge, Procedural Knowledge by students can improve the C/GPA by .430 & .235, respectively. The application of subtype of Declarative Knowledge could inversely minimize the student's academic achievement by -.221. Likewise, the other five subtypes of MAI Information including Debugging Strategies, Management Strategies & Planning could improve the student's performance (CGPA) by 0.101, 0.045, 0.118, respectively, whereas, student's performance (CGPA) could inversely affect up to -0.133, -0.225 by Monitoring and Evaluation respectively.

Conclusion

Metacognitive awareness has fruitful effect on academic achievements of students. The effects of metacognition on students' academic achievements is evaluated by Standardized Metacognitive Awareness Inventory (MAI), established in 1994 by Dennison & Schraw. The data showed that in Department of English, six out of eight subcategories significantly affected students' academic

achievement (CGPA) including Procedural Knowledge, Declarative Knowledge, Information Management Strategies, Debugging Strategies, Planning and Evaluation. However, the other two minor subtypes including Monitoring & Conditional knowledge insignificantly effected the students' academic achievement (CGPA). Furthermore, there was no correlation between Gender and MAI found in English Department.

The same analysis for pupils in Department of Mathematics exhibited that all eight sub-types has insignificantly affected students' academic achievement (CGPA). Likewise, data for English department, there was no correlation between Gender and MAI found in Mathematics students.

Discussion

Learning is a merely natural process which take place throughout the life, as an individual expose to the various events in his/her life. It is also time dependent process that means more exposure led to more learning. However, it depends on individual capabilities which a person has, that how much he/she can learn from a single event in life. The knowledge of metacognition and its appropriate application could be helpful in minimizing the individual's differential learning. The proper utilization of metacognitive strategies by subject tutors and respective students could lead to noteworthy impact academic achievements of students. Our data exhibited that the students' academic achievements were in direct relation to their metacognitive awareness. The previous reports were found in accordance to the outcomes of department of English in our study (Coutinho, 2007, Dunning et.al., 2003; Kodak & Boyacá, 2010; Ndidiamaka, 2010; Pintrich & De Groot, 1990; Sperling et.al., 2002; Taebee et.al., 1998; Young, Fry, & Jan, 2008). Furthermore, the student's data in Department of Mathematics produced insignificant effect on academic achievements (CGPA) of students who were metacognitively aware. The previous reports (Cubukcu, 2009; Mousoulides & Philippou, 2005) were in accordance to our findings.

Recommendations

For the purpose of improvement in achieving desired academic goals, we recommend the following points based on our data analysis and discussing it in light of related literature via Metacognitive Knowledge and Metacognitive Self-regulation.

1. Keeping in view the Metacognitive needs of students in both departments, curriculum may include an introductory course on Educational.
2. For improvement of Critical Thinking among the students in both departments, Faculty members might also be offered with refresher courses.
3. Teachers may also be trained for enabling the students on how to undertake self-questioning, self-assessment, self-regulation and thinking aloud during learning activities. If faculty in both departments of AWKUM lack the skill in that, then they might arrange training sessions for teaching faculty based on the recommended strategies of Metacognition Knowledge & Self-regulation.
4. Being the key target for learning, the students need to be evaluated by their tutors according to the parameters discussed in the present research. The students, failing to comply with the discussed parameters might be provided with appropriate proper counselling and/or guidance on the respective subject. The students counselling should be provided by the experts in the University, if not available at the institution, then sessions might be arranged on the monthly basis for such students by inviting the experts from other Universities.
5. Our data exhibited that the students tends to apply metacognitive strategies primarily for learn by rote instead of conceptual learning and comprehension. The tutors and counselling experts must focus on realizing the students that understanding the information is primary to memorizing, otherwise, it might lead them to be conceptually weak in the subject and unable for further learning.
6. Furthermore, the researchers need to evaluate the impact of application of metacognitive strategies in the various subjects excluding Mathematics & English. Moreover, the cultural diversity might be considered during future research regimes.

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