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University Students' Metacognitive Skills with Reference to Age, Discipline and Progression in Studies

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Abstract

The purpose of this quantitative study was to compare the metacognitive skills of university students' studying in medical, engineering, IT, sciences, social sciences, management sciences and commerce in public universities and medical colleges of Lahore. Universities were selected conveniently and students were selected randomly. Data were collected from 433 students from five public universities enrolled in different semesters of the academic year 2016. Metacognitive skills were measured by using Metacognitive Awareness Inventory (MAI) developed by Schraw and Dennison (1994). To address the research questions, statistical techniques such as descriptive statistics, independent sample t test and one way ANOVA, were used to analyze data. The study revealed that majority of the university students' had a medium level of metacognitive skills, and that the variables of age, major discipline, and the progression in studies had no effect on their level of metacognitive skills. The study informed the policy makers, curriculum planners, teachers and administrators that they are responsible for fostering the metacognitive skills of students may play an effective part in the society. The findings of the study might help to make desired changes in curriculum, pedagogy etc.

Keywords: University students, metacognition, metacognitive skills, discipline, progression in studies

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Introduction

Metacognition is known as thinking about thinking. Metacognitive skills are generally conceived as an organized understanding of skills used for learning and thinking, and integrate large portions of the abilities required for problem solving, critical thinking, dynamic learning, decision making and thoughtful judgment. It is considered that individuals with well-developed metacognitive skills are good in decision making and critical thinking and problem solving, are more capable and more inspired to learn, and will probably have the capacity to direct their feelings (even in hard circumstances), handle multifaceted nature, and adapt to resist (Dawson, 2008).When metacognitive skills are very much learned, that can be applied to different situations. It is vital for even the most exceptional grown-up learners to "utilize their cognitive muscles" by intentionally applying correct metacognitive skills to new information and in new circumstances.

Metacognition entails the use of systematic approaches to problem solving, along with the reflection and evaluation of these thinking processes (Cardelle-Elawar, 1992). It is comprised of a three stage hierarchical process involving minimal awareness, strategic use, and reflection of the thinking processes **(**Swartz &Perkins, 1990).Metacognition is one's capacity to use former information to arrange a procedure for approaching a learning assignment, detract necessary steps to problem solve, think about and assess results, and change one's approach as required. It helps learners decide the correct cognitive tool for the task and assumes a basic part in effective learning (Davidson & Sternberg, 1998; Sternberg & Hedlund, 2002).

Metacognitive skills and strategies play a vital role in all types of e.g. a daily life problem. Metacognitive skills are taken into account as the heart of the learning process asit emphasizes on developing thinking skills. Students find metacognitive skills and knowledge helpful in everyday life. But it has also been observed that most of the students even at university level face a great deal of difficulties in solving problems if their metacognitive skills are not so much groomed as they should be. So the study is designed to compare the metacognitive skills of university students' studying in different academic faculties including medical, engineering, IT, sciences, social sciences, management sciences and commerce of public universities and medical colleges of Lahore as it may differ. The results of the study will prove that it differs or not.

The assessment of students' metacognitive skills that they learn in their academic life and apply these skills to their everyday lives is vital for each institutions and public policy as instruction is progressively answerable for student outcomes. Therefore the study will inform the policy makers, curriculum planners, teachers and administrators responsible for fostering the metacognitive skills of students needed for playing an

effective part in the society. The findings of the study will help to make desired changes in curriculum, pedagogy etc.

Research Questions

1. What is the overall level of university students' metacognitive skills?
2. What is the level of university students' metacognitive skills with reference to conditional knowledge, procedural knowledge, declarative knowledge, planning, comprehension monitoring, debugging strategies, information management strategies, and evaluation?
3. Is there any difference in the level of university students' metacognitive skills based on demographic variables (age, major, year level and No. of years of learning mathematics)?

Metacognitive Framework

The Metacognitive Framework is a pedagogical device the researchers adopted to evaluate the university students' understanding and application of metacognitive skills. For which it shows that the theoretical foundation for this framework comes from the literature on metacognition (e.g., Schraw, Crippen, & Hartley, 2006) and models of problem solving (Polya, 1957; Resnick& Glaser, 1976).

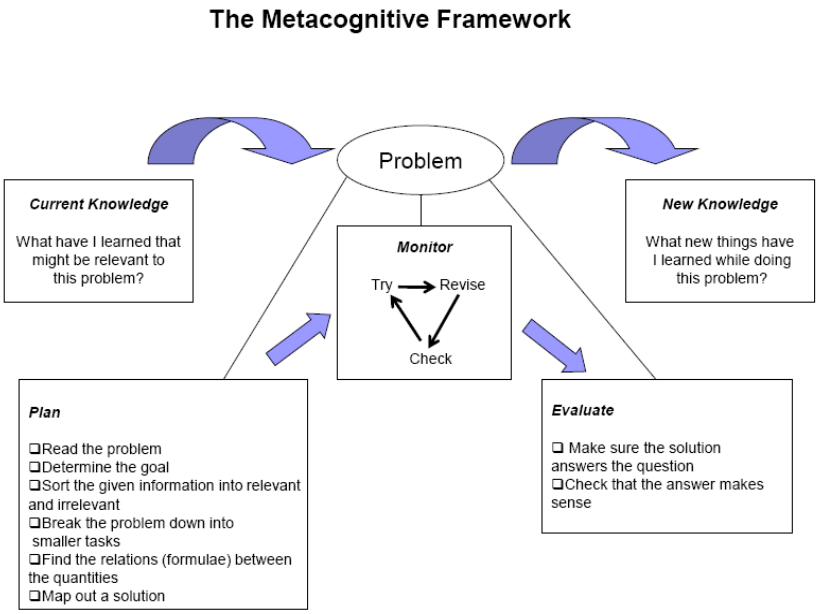

Figure 1: Metacognitive Framework (Francine Delvecchio, 2011)

Literature Review

According to Flavell (1976) who coined the term metacognition, wherever it absolutely was characterized as the disguise of discernment, a comprehension of insight, intends to regulate, arrange and suitably utilize it. He characterizes metacognition as Metacognition alludes to one's information concerning one's own particular psychological procedures and items or anything identified with them, e.g., the learning-significant properties of data or information. Metacognition alludes, in addition to other things, to the dynamic observing and subsequent control and arrangement of these procedures in connection to the psychological items or information on which they bear, for the most part in the administration of some solid objective or target.

As indicated by Schoenfeld (1987, 1992) Metacognition is thinking about our thinking and it involves the accompanying three vital viewpoints: learning about our own points of view, control or self-direction, and convictions and instinct. According to Schoenfeld (1987) Students need to wisely separate their time among (a) comprehension the problem, (b) arrangement, (c) selecting decisions on what to do, and (d) execution of the alternatives for a solution within the given period of time. During the time spent tackling a problem, they ought to screen and monitoring the advance to an answer. At the point when the choices appear not to work, they ought to attempt different choices or make some modification. Once a choice is made to go for new options, the work done ought not to be discarded. There is dependably a hazard that the diminished endeavors may have prompted to achievement".

Metacognitive Skills

Metacognition involves the utilization of deliberate methodologies to deal with problem solving, alongside the reflection and assessment of these reasoning procedures (Cardelle-Elawar, 1992).It is comprised of a three phase progressive methodology directing, including insignificant awareness, tactical use, and reflection of the thinking processes (Swartz & Perkins, 1990).

Garner (1987) contends that while cognitive skills are basic in executing a given errand, metacognition is a key component in seeing how to complete the assignment. The utilization of metacognition empowers understudies to improve their learning using control, technique, and reflection (Slavin, 1997). Various researchers define metacognitive awareness in terms of declarative, procedural, and conditional divisions (Jacobs & Paris, 1987; Schraw, 1998; Schraw & Moshman, 1995). Awareness of our thought process is intricate and all the more viably defended when partitioned into the different kinds of Awareness. These Awareness types are comprised of declarative, procedural, and conditional awareness.

Declarative knowledge obliges people to know about their learning styles and the range of components that impact one's achievement. *Procedural knowledge* permits people to perform assignments all the more consequently, as they ordinarily have more systems and can apply such techniques the more efficiently. *Conditional knowledge* obliges one to know when certain methodologies ought to be utilized and why. One way procedural knowledge can be utilized to enhance errand effectiveness by using chunking and classifying data to help review. This is a useful example of how procedural knowledge can be utilized to enhance one's memory execution. Knowing when declarative and procedural knowledge ought to be used and why conditional awareness is essential will make it less demanding for students to adapt and adjust to changing situational needs (Schraw, 1998)

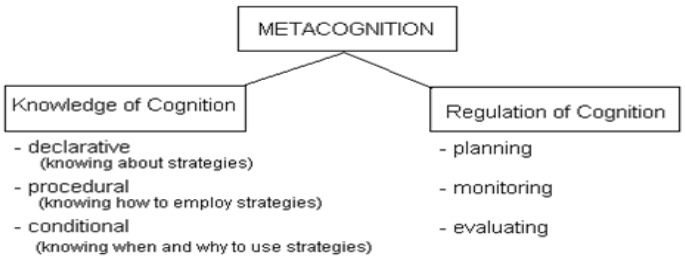

Figure 2: Components of Metacognition

Strategic use of thinking processes and reflective thinking can be gathered under what are sometimes referred to as regulatory processes. Regulating skills rely on one's competence to arrange or select proper methodologies, monitor or assess task understanding and execution, and assess errand result and productivity. Research indicates that these aptitudes by and large create with preparation and practice. In fact, Berieter and Scardamalia (1987) found that the arranging capacity of talented authors created all through youth and puberty, and enhanced significantly between the ages of ten and fourteen. Being a valuable problem solver includes the obtaining of certain metacognitive skills, which the individual can sum up to different problem or circumstances and apply in a methodical way.

The literature shows that there are different contrasts that recognize successful from non-powerful learners regarding metacognitive capacities. Specialists have found that skillful scholars apply metacognitive aptitudes to precisely assess the measure of learning that has been procured, screen present and nonstop learning, revise gained knowledge, and create viable strategies for getting new data (Baker, 1989; Garner & Alexander, 1989; Pressley & Ghatala, 1990).

The significance of procuring such abilities is emphasized when one considers the nature in which such abilities are obtained. Classroom situations oblige students to end up distinctly capable in various ability zones inside an organized timeframe. Under these conditions, learners who have the ability to use metacognitive skills have a favorable element in that they have the capacity to assess what is already known and utilize that to consolidate as of newly gained information (Bjork, 1994; Davidson, Deuser& Sternberg, 1994). In short, the most productive approach to consolidate new information into our knowledge base is to draw upon with respect to what we definitely know.

The impact of students' cognitive abilities should be tended to give a convincing contention that metacognitive skills empower students to be more powerful and productive learners. The research proposes that capability in acquiring metacognitive skills does not firmly rely upon one's cognitive ability or IQ. It has been contended that IQ may greaterly affect skill development in the introductory stages; in any case, amid the later phases of skill acquisition, IQ is thought to apply far less impact. Truth be told, the utilization of viable procedures might adjust for IQ, to a certain level.

Swanson (1990) analyzed problem-solving skills in 5th and 6th-grade students and found that students with high metacognitive skills utilized fewer strategies, yet were more powerful problem solvers than students with low metacognitive skills, apart from capacity level. This proposes overall metacognitive skills might adjust for IQ and might help to problem solving abilities (Swanson, 1990).While metacognition and intelligence have a slight positive connection, the two don't have all the earmarks of being unequivocally related (Alexander, Carr, Schwanenflugel, 1995).This suggests that a high IQ is not essential to achieve metacognitive skills.

Method and Procedure

The nature of the study was quantitative by using survey method. To get the true representative sample out of accessible population, two public universities, two medical colleges and one engineering University were conveniently selected. In all, the data were collected from 433 students selected randomly who were enrolled in different programs and were at different stages of their degree programs. Among participants (275) were female (63.5 %) and (158) were male (36.5 %).

Instrumentation

To assess the student's metacognitive skills' level, the researcher utilized the Metacognition Awareness Inventory (MAI) developed by Schraw and Dennison (1994). The MAI is five-point Likert scale that comprised 52 items with 8 factors with scales as (1) Almost never,(2)Seldom, (3) Sometimes; (4) frequently; (5) almost always).

The range for average score that a respondent gets in the Metacognition Awareness Inventory is in the vicinity of 52 and 260. The level of metacognition is classified as low for 52 to 121 scores (20% - 46.5%), moderate for 122 to 191 (46.6% - 73.5%) scores and high for 192 to 260 scores(73. 6% - 100%).

Data Collection

The researcher herself visited the institutions for collecting data. The response rate was 433 students out of 600.

Analysis and Interpretation of Data

Table 1

MAI's Factor-wise Comparison of Level of University Students' Metacognitive Skills

	Levels		
Variables	Low	Moderate	High
Declarative Knowledge	80 (18.5%)	152 (35.1%)	201 (46.4%)
Procedural Knowledge	69 (15.9%)	99 (22.9%)	265 (61.2%)
Conditional Knowledge	110 (25.4%)	108 (24.9%)	215 (49.7%)
Planning	306 (70.7%)	127 (29.3%)	0 (0%)
Information Management Strategies	127 (29.3%)	94 (21.7%)	212 (49.0%)
Comprehension Monitoring	104 (24.0%)	168 (38.8%)	161 (37.2%)
Debugging Strategies	98 (22.6%)	165 (38.1%)	170 (39.3%)
Evaluation	74 (17.1%)	175 (40.4%)	184 (42.5%)
Overall Metacognition	38 (8.8%)	229 (52.9%)	166 (38.3%)

The results of the above table show that the university student's level of metacognitive skills was found to be high in Declarative Knowledge with a percentage of 46.4%, in Procedural Knowledge with a percentage of 61.2% and in Conditional Knowledge with a percentage of 49.7% whereas the level of university students' in Planning was found low with percentage of 70.7%. The level of university students' in Information Management strategies (49.0%), Comprehension monitoring (37.2%), Debugging Strategies (39.3%) and Evaluation (42.5%) was also found high. Results indicate that the majority of respondent's use of metacognitive skills in Overall Metacognition was found to be moderate (52.9%).

Table 2

Age -Wise Comparison of Level of University Students' Metacognitive Skills

MAI: S Scales	Age	*M*	*SD*	*Df*	*t*
PK	Less than 20 years	13.06	2.732	431	.118
	Older than 20 years	13.02	2.918		
CK	Less than 20 years	16.72	3.245	431	.557
	Older than 20 years	16.55	3.361		
DK	Less than 20 years	26.20	5.268	431	.901
	Older than 20 years	25.75	5.218		
P	Less than 20 years	24.28	3.738	431	-.135
	Older than 20 years	24.33	4.097		
DS	Less than 20 years	17.02	3.561	431	.265
	Older than 20 years	16.93	3.465		
IMS	Less than 20 years	34.28	5.406	431	-.608
	Older than 20 years	34.60	5.542		
CM	Less than 20 years	22.07	5.048	431	.230
	Older than 20 years	21.96	4.779		
E	Less than 20 years	20.45	3.680	431	-.362
	Older than 20 years	20.58	3.736		
O:MAI	Less than 20 years	174.1	25.700	431	.146
	Older than 20 years	173.7	25.905		

Note: PK=Procedural Knowledge; CK=Conditional Knowledge; DK=Declarative Knowledge; P=Planning; DS=Debugging Strategies; IMS=Information Management Strategies; CM=Comprehension Monitoring; E=Evaluation; O: MAI=Overall Metacognition.

Independent sample t-test was applied to compare the mean MAI score of university students with ages less than 20 years and students with ages older than 20 years. The result of Table 2 shows that there is no significant difference between metacognitive skills of university students with ages less than 20 years and students with ages older than 20 years in the sub-scales of metacognitive skills as well as in overall metacognitive scale itself, t (433) = .146, p= .696

Table 3(A)

Analysis of Variance in Major Disciplines of University Students'

	Major									
	M		Eng		IT		Sci		ANOVA	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F(6, 426)*	*p*
PK	12.97	2.79	13.46	2.99	13.02	2.86	12.92	2.71	.288	.943
CK	16.74	3.19	16.97	3.23	16.94	3.32	16.07	3.40	.669	.695
DK	25.83	5.07	26.24	5.10	26.63	5.15	25.10	5.07	.877	.512
P	24.36	3.90	24.42	4.19	24.43	3.44	23.78	4.09	.558	.764
DS	17.05	3.45	17.00	3.49	17.07	3.40	16.71	3.58	.348	.911
IMS	34.49	5.45	34.95	5.51	34.85	5.49	33.39	5.41	.839	.541
CM	22.41	4.70	22.18	5.01	22.26	5.29	21.71	4.69	.262	.954
E	20.57	3.60	20.24	3.64	20.59	3.78	20.37	3.73	.344	.913
O: MAI	174.4	24.8	175.5	25.3	175.8	26.1	170.0	25.2	.539	.778

Note= p< .05

University students' major discipline wise scores on eight factors and overall MAI were subjected to analysis of the variance. The seven major disciplines (medical, engineering, IT, sciences, social sciences, management sciences and commerce) were chosen to analyze sub-scales and overall metacognition of university students. Results of analysis of variance for the first four major disciplines (medical, engineering, IT, sciences) is presented in table 3(A) whereas the results of other three major disciplines (social sciences, management sciences and commerce) is presented in table 3(B).

Results of analysis of variance for the factors of MAI presented in table 3(A) show that (F(6,426) = .539, p>0.05), indicating there is no statistically significant difference in mean scores of university students' with major disciplines of Medical, Engineering, IT and Sciences. For overall MAI no significant difference was found in the mean scores as well.

Table 3(B)

Analysis of Variance in Major Disciplines of University Students'

	Major						ANOVA	
	S.Sci		M.Sci		Com			
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F(6, 426)*	*P*
PK	13.16	3.01	13.03	2.59	12.82	2.72	.288	.943
CK	16.72	3.35	16.88	3.17	16.31	3.39	.669	.695
DK	26.36	5.83	26.96	5.26	25.39	5.23	.877	.512
P	24.86	4.13	23.77	3.57	24.15	3.93	.558	.764
DS	17.41	3.75	16.85	3.40	16.63	3.53	.348	.911
IMS	35.14	5.71	33.96	5.11	34.05	5.37	.839	.541
CM	21.67	5.21	21.85	5.22	21.79	4.62	.262	.954
E	21.00	3.73	20.03	3.98	20.39	3.71	.344	.913
Overall MAI	176.3	28.3	173.3	26.3	171.5	24.8	.539	.778

Results of analysis of variance for the factors of MAI presented in table 3(B) shows that($F(6,426) = .539$, $p>0.05$), indicating there is no statistically significant difference in mean scores of university students' with major disciplines of social sciences, management sciences and commerce as well. There was no significant difference found in the mean scores of overall MAI as well.

Table 4

Analysis of Variance in Academic Years of University Students'

	Years								ANOVA	
	1st Year		2nd Year		3rd Year		4th Year			
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F(3, 429)*	*P*
PK	13.06	2.72	12.98	2.76	13.03	2.80	13.16	3.25	.055	.983
CK	16.63	3.18	16.80	3.18	16.65	3.51	16.28	3.50	.314	.815
DK	25.96	5.29	26.04	5.15	26.06	5.17	25.79	5.58	.037	.990
P	24.26	3.84	24.33	3.89	24.24	3.78	24.45	4.42	.040	.989
DS	17.08	3.53	16.86	3.50	17.10	3.54	16.75	3.50	.201	.895
IMS	34.31	5.56	34.28	5.30	34.33	5.35	35.35	5.83	.567	.637
CM	21.86	5.22	22.34	4.66	22.32	4.77	21.07	4.86	.1.014	.386
E	20.38	3.83	20.57	3.59	20.54	3.67	20.67	3.73	.105	.957

O: MAI	173.5	27.22	174.2	23.95	174.3	25.38	173.5	27.14	.026	.994

University students' academic year wise scores on eight factors and overall MAI were subjected to analysis of the variance. The programs having semester system was converted in years as two semesters=one years.

Results of analysis of variance for the eight factors and overall MAI presented in Table 4 shows that($F(3,429) = .026$, $p>0.05$), indicating there is no statistically significant difference in mean scores of university students' who were studying in 1st, 2nd, 3rd and 4th academic year.

Table 5

Analysis of Variance in No. of Years Learning Maths of University Students'

	No. of Years learning Maths								ANOVA	
	1-10 Years		11-12 Years		13-14 Years		More than 14 Years			
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F(3, 429)*	*P*
PK	13.16	2.80	13.01	2.88	12.72	2.65	13.44	3.29	.596	.618
CK	16.77	3.27	16.58	3.36	16.53	3.14	16.05	3.93	.345	.793
DK	26.18	5.27	26.41	5.44	24.92	4.89	25.72	4.84	1.543	.203
P	24.49	3.87	24.20	4.08	23.82	3.74	25.11	3.75	.876	.454
DS	17.04	3.48	17.40	3.45	16.00	3.48	17.94	3.65	3.325	.020
IMS	34.73	5.47	34.71	5.39	33.16	5.59	35.11	4.86	1.929	.124
CM	22.24	4.97	21.74	4.73	21.95	4.97	21.61	5.48	.324	.808
E	20.78	3.61	20.44	3.76	19.76	3.80	21.44	3.48	1.931	.124
O: MAI	175.4	25.93	174.5	25.78	168.8	24.85	176.4	27.05	1.388	.246

University students' No. of years learning maths wise scores on eight factors and overall MAI were subjected to analysis of the variance. Results of analysis of variance for the eight factors and overall MAI presented in Table 5 shows that ($F(3,429) = 1.388$,

p>0.05), indicating there is no statistically significant difference in mean scores of university students' with different number of years learning maths.

Results and Discussion

Most of the university students' metacognitive skills' level was found moderate and these results are aligned with the results of similar study conducted by (Aljaberi & Gheith,2014) which showed that which showed that the larger part of respondents were utilized moderate level of metacognitive skills in University of Petra, Jordan however this outcome does not run as per the results of(Al-Hamouri & Abu Mokh, 2011), which demonstrated that the metacognitive skills' level of students was nearly high.

This difference in metacognitive skills' level may be a reason of that in our education system; the scholars don't seem to apply their metacognitive skills. More focus of our education system is on memorization rather than to enhance the critical thinking ability and metacognitive skills of students. That's why majority of our students are unable to understand the problems whether these are their real life problems or mathematical problems. Even most of the students at university level do not know how to handle these problems, how to use their metacognitive skills for solving real life problems and mathematical problems. The level of university student's metacognitive skills was found to be high in Procedural Knowledge, Declarative Knowledge, Conditional Knowledge, Information Management strategies, Debugging Strategies, Comprehension Monitoring and Evaluation. But the level of university students' was found low in Planning. These results are not aligned with the results of similar study conducted by (Aljaberi& Gheith, 2014) which reported that the university students' level of metacognitive skills was moderate in all the eight factors of Metacognition Awareness Inventory (MAI).

The difference might be as a result of the social environment that may influence the encounters people have picked up and the way they learn. Outcomes of this review are in accordance with the consequences of some past reviews as to the metacognitive skills' level throughout the eight elements (Yunus& Ali, 2009) that indicated high level of metacognitive skills in the following factors: Debugging strategies, Information Management strategy & Conditional knowledge when contrasted with Procedural knowledge, Comprehension Monitoring, Planning & Declarative Knowledge. It is additionally in accordance to the review directed by (Aljarah & Obeidat, 2011), that exhibited that metacognitive skills' level of students was higher in the information management strategy. While the results of these studies demonstrated that students have low level of skills in organization and planning.

No significant difference was found between metacognitive skills of university students with ages less than 20 years and students with ages older than 20 years in the sub-scales of metacognitive skills as well as in overall metacognitive scale itself. The researches do not support or contradict these results.

No significant difference was found in means of university students' with major disciplines of medical, engineering, IT, sciences, social sciences, management sciences and commerce in the sub-scales of metacognitive skills as well as in the overall metacognitive scale itself. these results are consistent with the results of similar study conducted by (Aljaberi & Gheith,2014) which also showed no significant differences in the means of university students' studying in different faculties in the sub-scales of metacognitive skills as well as in overall metacognitive scale itself. The results could be same due to the same conditions in both studies.

The outcomes demonstrate no significant difference in means of university students 'who were studying in different semesters of academic year, 2016. The results of the similar study conducted by (Aljaberi & Gheith, 2014) also support the results that no differences have been found among mean scores of students on the basis of their academic year in which they were studying presently. These results are additionally in accordance with a review (Abu-Alia & Alwaher, 2001; Al-Hamouri & Abu Mokh, 2011; Zulkiply et al., 2008).

Mean scores of university students' who learnt/studied maths for 1-10 years, 11-12 years, 13-14 years or more than 14 years do not reflect any significant difference in metacognitive skills of university students. No study was found to compare the results in this perspective which calls for further research. The researches do not support or contradict these results.

Recommendations

On the basis of the findings-1 that the majority of respondent's level of metacognitive skills in Overall Metacognition was found to be moderate following recommendations have been made:

1. More attention should be paid for the improvement of metacognitive skills at all academic levels, from school level to university level.
2. Such academic courses should be infused that deal with metacognitive skills.
3. Instructors should be encouraged to widen metacognitive skills of the students by using particular teaching methodologies to develop thinking.
4. Different workshops on metacognitive skills should be conducted for the teachers as well as students.

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