Meta-Cognition, Academic Motivation, Problem Solving Evaluation and Academic Performance of Chemistry: Correlation Study

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A B S T R A C T

This study aimed to investigate the relationship between meta-cognition, academic motivation and problem solving evaluation with academic performance of female secondary school students of second educational district of Bandar Abbas (in Iran) in Chemistry. The statistical population of the study consisted of all female secondary school students of District 2 in Bandar Abbas city in 2015-16. Among them, 245 subjects were selected by simple random sampling without replacement. O'Neill and Abedi (1996) meta-cognitive questionnaire, academic motivation questionnaire of Hermence (1997) and Heppner and Petersen questionnaire of problem-solving assessment (1998) were used to collect the data. In this study, Chemistry score of provincial test in February in 2016 was used as the indicator of their academic performance. The data of the questionnaire were analyzed using multivariate regression analysis. Statistical test findings showed that meta-cognition explains the academic performance by determination coefficient as 0.38 significantly and positively. Academic motivation also predicts the academic performance of students by determination coefficient as 0.26 significantly and positively. The problem-solving evaluation also predicts the academic performance of students by determination coefficient as 0.2 significantly and positively. Therefore, it can be concluded that meta-cognition, academic motivation and evaluation of problem-solving in students has a positive and significant relationship with their academic performance in Chemistry. Academic performance quality will be improved by training the subscales of meta-cognition, academic motivation and problem solving evaluation.

Keywords: Meta-Cognition, Academic Motivation, Problem Solving Evaluation, Academic Performance In Chemistry.

INTRODUCTION

One of the criteria of the educational system efficiency is the achievement and the drop out of the students. Exploitation and the study of the effective research variables on these variables will lead to better and the prediction of the

effective factors at school[1]. So, studying variables, as correlated with academic achievement in various subjects, is one of the fundamental issues in the education system. The academic achievement points out to school learning evaluated by various lesson tests. So, the main purpose of education or training is to create positive changes in the behavior of the person as in knowledge, skills and attitudes[2]. To achieve this objective, behavioral scientists have proposed different theories and methods appropriate to changes of education. One of these ways is meta-cognition.

Meta-cognition is said to information that the person has of his own cognitive system[3]. Meta-cognition is a multifaceted concept that includes knowledge, belief, processing and strategies that are responsible for assessment, monitoring and cognitive control[4]. In the field of learning transfer, it should be said that since meta-cognitive knowledge is likely to be the basis for learning how to learn, so the acquisition of such knowledge as the knowledge of rules, strategies and objectives makes people to be more efficient and more flexible to adapt cognitive abilities with their new assignment. Extensive research results on the role of meta-cognition in problem-solving, reading, writing, learning and so on suggests that the current system of education must be moved to an emphasis on meta-cognition. If Education Department is after the education of students who are able to come over various problems of the future evolutionary society and accept the responsibility of their learning, they should enter meta-cognition in their planning and pay attention to the development of the meta-cognition skills. Because the meta-cognitive skills help people adapt themselves to the new position[6]. The awareness of each student of his abilities will affect the continuation of the academic trend[7].

Academic motivation is of other practices on academic performance. Academic motivation is the main worry of most teachers and plays a very important and dominant role among the various individual and environmental effecting factors of learning and academic achievement of learners. Therefore, appropriate knowledge and analyzing the motivation for efficiency and effectiveness of teaching and learning is very important. Motivation makes students ready to get the motive or specific motive. Several factors such as changing, frequency and recent intensity have significant effect in attracting attention. But what attracts attention of students for a certain period on a particular subject is their motivation and interest. Motivation and interest constitute the starting point of activities in education. The student should be interested in a topic for paying attention to a particular subject. The relationship of educational content with student requirements causes them to be satisfied with lesson context[8]. Academic motivation achievement of students is under the influence of biological, psychological and social factors. These factors can be classified in multi-level factors, including those related to the student, family, school, society and outside the schools environment factors. If a society wants to

develop along with the global science progress, it should pay attention to the role of these factors and should not ignore it. Ignoring the above factors is actually purposeless and mal-planned investment in education that will be followed by irrecoverable damages to financial and human resources[9]. Motivation not only effects on the academic achievement but also is affected by the academic experiences (success, failure and its consequences).

What the research show is that a considerable number of students fail in their learning process and their objectives are not completely met despite the physical and spiritual investments of the educational centers and families. Given the impact of the educational system, family and social environment, it is necessary to take more desirable actions in order to create academic achievement motivation in them. Of other practices of academic performance can be problem solving evaluation. Problem solving is a part of thought that is considered as the most complex part of each thought process. It is defined as an important cognitive trend that requires dictation and halter of a set of basic and common skills[10].

The concept for systematic problem solving in education was first introduced by John Dewey and Vygostsky. Today, the importance of problem solving skill is clear to all and its importance in the modern world is changing and increasing. Whatever learners get nearer to the high levels of education, they should strengthen their problem solving skills more independently in order to reduce their dependence to the instructor. Problem solving skill of individuals is related to their concentration on the problem and their evaluation. Problem solving skill is a cognitive activity and valuable objective and improvement of problem solving skill through education[11]. Problem solving is a practical and coping skill that causes the self-confidence increase and is related to the personal compatibility including: self-understanding, problem definition, a list of various solutions, making decisions about the best solution and testing the selective solution 10. Therefore, learning problem solving skill at different levels can help the creative solution of a problem or academic achievement in higher levels that leads to innovation and invention.

METHODOLOGY

As the researcher of the study sought to determine the relationship between meta-cognition, academic motivation and problem solving performance of female students in chemistry course, so descriptive-correlation method is selected. The statistical population of the study consisted of secondary school students in mathematics and experimental sciences majors who are studying chemistry and educate in Bandar Abbas in 2015-16 academic years.

Criteria and entry requirements of high school adolescents in this study include:

• Female adolescents who are studying Chemistry in Experimental sciences or Mathematics.

• Female adolescents participated in the third year provincial test of secondary school assessment and have provincial test academic performance scores.

• Female adolescents who were willing to cooperate to receive and fill out the questionnaire.

The sampling method of this study is cluster sampling. To this end, of the Girls High School in District 2 of Bandar Abbas, five high schools were selected. The following questionnaires were used to collect information.

1. Inventory of meta-cognitive state:

This questionnaire is made by Harlod O'Neill (1996) and three principles of brevity, reliability and ability was considered for developing the questionnaire and the eighth to twelfth grade students and Associate students and exploratory factor analysis results includes twenty multiple choice questions were identified as followed.

1. Meta-cognitive awareness

2. Meta-cognitive strategy

3. Planning

4. The self-revision

Factor analysis results of construct validity and correlation coefficient is significant with academic achievement tests that indicate the predictive validity of the questionnaire; each question is scored based on a four-point Likert scale (1 to 4); score range fluctuates (from 20 to 80) as (strongly disagree = 1), (disagree = 2), (agree = 3), (strongly agree = 4) respectively. In this study, the questionnaire reliability is calculated as equal to 0.83.

2. Academic Motivation Inventory (A.M.T) of Hermance:

Achievement motivation questionnaire of Hermance (1977) is made based on experimental and theoretical knowledge about the need for progress with the literature review related to the need for progress in this questionnaire. The initial questionnaire has 29 questions. In the present study, the reliability of the questionnaire was calculated as 0.75.

3. Problem Solving Inventory (PSI):

Quoted in Larson, Pantza and Vensted (1995), Heppner and Kraskov (1987) know problem solving as a series of behavioral, cognitive and affective responses that have been expressed in order to adapt to internal and external challenges. In the present study, the reliability of the questionnaire was calculated as 0.75.

4. Academic Performance:

A researcher-made checklist was used in order to gather information about the academic performance which was collected in this way and according to general provincial test scores in February in 2015.

Descriptive statistics indexes such as mean and standard deviation for the analysis and inferential statistics using multivariate regression analysis was used to test hypotheses.

RESULTS

The descriptive results (descriptive statistics of the study sample) statistical distribution of the relationship of meta-cognition, academic motivation and problem solving evaluation with academic performance of students in the third year of secondary school in chemistry course:

Table1. Mean and standard deviation of studied indicators

Variables	Minimum	Maximum	Mean	Standard deviation
meta-cognition	39	94	60.20	7.440
academic motivation	62	103	82.87	7.214
problem solving evaluation	69	134	103.93	11.991
academic performance	4	20	15.86	3.306

In the following, the statistical analyses through regression analysis based on the presented hypotheses are presented.

Table2. The regression model results of the relationship of meta-cognition and academic performance

	Beta	t	p
Meta-cognitive self-revision	0.4	2.24	0.03
Meta-cognitive awareness	0.42	2.38	0.02
Meta-cognitive strategy	0.27	1.99	0.04
Meta-cognitive planning	0.65	3.86	0.001
R		0.62	
R-squared		0.38	
F-static		3.89	
p-value		0.04	

According to the table above, the regression model in this hypothesis showed that the determination coefficient for the model is equal to 0.38. This means that meta-cognition explains (predicts) 38 % of the academic performance of students.

Table3. The regression model results of the relationship between motivation and academic performance

	Beta	T	p
academic motivation	0.19	2.28	0.03
R		0.51	
R-squared		0.26	
F-static		3.92	
p-value		0.03	

According to the table above, the regression model in this hypothesis showed that the determination coefficient for the model is equal to 0.26. This means that motivation explains (predicts) 26 % of the academic performance of students.

Table4. The regression model results of the relationship between problem solving evaluation and academic performance

Explanation	Beta	T	P
Tendency and avoidance style (Beta)	0.178	1.68	0.07
Trust in solving problem (Beta)	0.34	2.53	0.02
Self-control in problem solving (Beta)	0.50	5.18	0.04
R		0.45	
R-squared		0.20	
F-static		3.19	
p-value		0.049	

According to the table above, the regression model in this hypothesis showed that the determination coefficient for the model is equal to 0.20. This means that problem solving evaluation explains (predicts) 20 % of the academic performance of students.

CONCLUSION

This study aimed to investigate the relationship between meta-cognition, academic motivation and evaluation of problem solving on the academic

performance of female secondary school students in chemistry course in 2nd Education District in Bandar Abbas. The statistical results showed a significant relationship between meta-cognition and academic motivation and problem-solving evaluation with academic performance of female students in chemistry. Therefore, we find out that students who benefit high meta-cognitive knowledge (knowledge about the self, task, cognitive strategy) and experience and regulation of cognition (meta-cognitive knowledge, cognitive strategies, planning, self-revision) improve their learning and academic performance due to the understanding of the person about his abilities and knowing cognitive strategies and because meta-cognition has a positive relationship with comprehension therefore, students who know themselves more efficient have better cognitive and meta-cognitive strategies and are more successful in solving the problem. Also, they are students who have higher academic motivation and can try spontaneous and without the need for external stimulus and achieve their academic success. Both intrinsic motivation (interest in study and curiosity) and extrinsic motivation (rewards and incentives in exchange for study) can play an important role in the willingness of the individual to study and thus increase their academic performance and their success. On the other hand, problem-solving should not be viewed only on the basis of individual knowledge, although processing will be done on the same basic knowledge; but more important is the process of acquiring this basic knowledge in case the students are fluent in the use of problem-solving. In the face of scientific and social problems, these students can be more successful in problem solving and perform more desirable performance since this pattern motivates students to nurture new and creative ideas and use them in new situations and make an innovation.

Therefore, we conclude that it is necessary for our education system to emphasis on the especial skills to move towards basic skills. For learning how to learn, it is necessary to include reasoning principle in the curriculum and teachers should guide students towards reflective thinking rather than book contents. Students should be viewed as dynamic and active information processors that explore in the learning process.

Meta-cognition strategies and academic motivation and problem-solving model should be paid more attention to at schools in order to have a mighty, joyful and educated society in the future and rely on our abilities to meet our needs.

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