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**A SURVEY OF THE EFFECT OF TRAINING COGNITIVE AND META-COGNITIVE
STRATEGIES ON LEARNING AND INTRINSIC COGNITIVE LOAD ON
PHARMACOLOGY OF NURSING**

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ABSTRACT

This study aimed to investigate the effect of training cognitive and meta-cognitive strategies on learning and intrinsic cognitive load on pharmacology in nursing. Pre-test, post-test study with control group is applied. The study population is all students in nursing school of Malayer who had pharmacology textbook in the second half of academic year 2014-2015 in their selected textbooks. By convenient sampling method, two 15-people closes (totally 30) were selected as study sample. The study measure is learning test (Cronbach's alpha reliability for pre-test 0.82 and post-test 0.79 and validity support) and intrinsic cognitive load questionnaires. For data analysis, independent t-test is used by SPSS, version 18 software. The study findings show the increase of learning and reduction of intrinsic cognitive load for students in pharmacology. Based on the impact of cognitive and metacognitive strategies on learning and intrinsic cognitive load in pharmacology, it is recommended to training experts to be familiar with cognitive and metacognitive strategies and apply these strategies in learning-teaching process.

**Keywords: Cognitive and metacognitive strategies, Learning, Intrinsic cognitive load,
Pharmacology**

INTRODUCTION

One of the most important learning strategies is cognitive and meta-cognitive strategies. The term recognition refers to mental processes or the methods by which information is processed, the information is considered, identified, encoded, stored and applied in appropriate cases (Bieler & Snowman, 1993). Cognitive strategies refer to any behavior, thought or practice as applied by learner during learning and the aim is helping learning, organizing, storage of knowledge, skills and easy operation in future (Weinstein & Hume, 1998, p:12). The comprehensive definition of metacognition is challenging. However, most researchers agree that metacognition is recognition of cognition or knowledge. Exactly, metacognition is one's knowledge about his learning (slavin, 2008). Flavell defines metacognition as awareness of cognition and cognitive processes and control, regulation and active revision of cognition (Flavell, 1976). Study and learning strategies (cognitive and metacognition), methods and proper strategies for study, learning method, proper use of learning processes and academic achievement of learners at different ages and academic levels in which curriculum is included (Kadiver, 2005).

Cognitive theorists believe that mental processes of learner, the method by which the learner processes the information, applies it and can change the mental structures and thoughts and they are main factors in learning explanation. One of the main theories of cognitive theory is information processing. This theory refers to three types of Sensory Memory, Short-Term Memory (STM) or Working Memory or Long-Term Memory (LTM) in cognitive system of human being (Biabangard, 2011). Various factors are involved in learning of learners. One of the most important factors is using cognitive strategies by them and considering the limitations of cognitive process by designers and education experts. Cognitive load theory was developed for the first time in 1950. This theory is based on the assumption that communication channels have limited capacity to send information. This theory states that cognitive capacity of human being is limited. We can process limited number of information units at the same time. The term cognitive load is the load imposed during information process on working or short-term memory to encode the information for placement in long-term memory. This mental effort to process

information is called cognitive load (Kalyuga, 2012).

Based on cognitive architecture of human being, cognitive load theory proposes that the main goal of education is increase of useful knowledge retained in long-term memory. The amount of this knowledge is considered based on working memory limitations. It is required that the information is presented to learner as unnecessary processing is reduced. Thus cognitive load theory is regarding the procedures presenting new information to the learners to eliminate unnecessary cognitive load and improve the aspects of cognitive load leading to learning (Amir Teimuri and Zare, 2015). Cognitive load theory is one of the most important theories in educational design. The goal of cognitive load theory is prediction of learning outcomes based on capabilities and limitations of cognitive structure of human being (Plass et al., 2010). This theory can be applied in wide range of learning environments as it associates design of curriculum features to information processing principles in human cognitive structure. In learning and teaching process, some of educational textbooks are simple or difficult. Some contents require learning the elements as independent but others need communication between some information elements. Besides the number of elements

and Element Interactivity of educational content, the textbook presentation and the learner himself (in case have little experience regarding educational content) can increase cognitive load. The researches have defined three types of cognitive load: Intrinsic cognitive load, extraneous cognitive load and germane cognitive load (Paas et al., 2003).

Intrinsic cognitive load is defined based on mental complexity of learning curriculum (Kalyuga, 2012). Intrinsic cognitive load as the first cognitive load type is defined based on Element Interactivity of content. As educational designer, we have no control on content Element Interactivity. If there is high level of interaction between content elements, the intrinsic cognitive load of the content is high but if Element Interactivity of content is low, its internal cognitive load is reduced (Morrison et al., 2004). Intrinsic cognitive load of an educational content is imposed by the basic structure of the information that learner needs to achieve learning goals ignoring educational procedures being required. This load is based on intrinsic complexity of educational content and indicates its difficulty for learning. The main reason of imposing cognitive load by complex educational content is that the elements of these educational contents have high interactions

compared to simple educational content and these elements are in working memory of learner simultaneously (Amir Teimuri and Zare, 2015).

Extraneous cognitive load is based on different forms of design and educational content to learners (e.g. writing, practical presentation or activities as problem solving, study of practical examples, etc.) (Kalyuga, 2012). Extraneous cognitive load is formed during design or arrangement of curriculum. By exact application of educational design recommendations and message design principles, we can control extraneous cognitive load on learner (Zare et al., 2015). Extraneous cognitive load is the result of the method by which information is presented to learners.

Germane cognitive load arising from useful cognitive activities of learning is used to refer to the requirements of learning in working memory and it is added to this theory in the next stages (Van merriënboer & Pass, 1994; Sweller & Van merriënboer & Pass, 1998). The term “Germane cognitive load” is used to refer to germane resources for learning.

Germane cognitive load is referred to mental efforts of learner imposed to achieve new mental schema, educational content learning and learning automation. The knowledge and

skills applied frequently by learner can be used automatically, without high conscious efforts. Automation of learnt content can cope up with limitations of working memory and reduces cognitive load. As educational designer, we should increase this type of cognitive load in designed educational content (Amir Teimuri and Zare, 2015). It seems that using learning cognitive strategies by learners can reduce cognitive load. Many researches have been conducted in application of cognitive strategies on learning. There is no study regarding cognitive strategies beside cognitive load theory. Some of the researches are referred as:

Relatively high researches have been conducted regarding training and using cognitive and meta-cognitive strategies in learning-teaching process as Maleki (2005), Malekian et al., (2010), Nasim et al., (2013), Mohammadi Darvish and Baghal et al., (2013), Salehi et al., (2013) and Efklides (2011). The studies show the effectiveness of cognitive and metacognitive strategies on learning and teaching process. Regarding cognitive and learning load, some studies have been conducted as Mosa Ramezani et al., (2013), Zare (2014) and Zare et al., (2015). The results of study showed that if cognitive load is low, learning is increased.

There is no study regarding cognitive and metacognitive strategies on learning and intrinsic cognitive load and it is the difference of this study with other studies.

The present study aimed to evaluate the effect of cognitive and metacognitive strategies on intrinsic cognitive load and learning on pharmacology in nursing.

Study hypotheses include:

1- There is a significant difference between learning of experiment group learning pharmacology textbook with cognitive and metacognitive strategies and control group training the same content without cognitive and metacognitive strategies.

2- There is a significant difference between intrinsic cognitive load on experiment group learning pharmacology textbook with cognitive and metacognitive strategies and control group subjects learning the same content without cognitive and metacognitive strategies.

METHODS

The present study is quasi-experimental with pre-test, post-test with control group. The study population is all students of nursing school in Malayer city in second half year of academic year 2014-2015 learning pharmacology in the selected list. Convenient sampling method is used and two classes as

15 (totally 30) are selected and considered randomly as one control group and experiment group. Pharmacology education was performed of two pre-test groups. Then, cognitive and metacognitive strategies are given to experiment group during 2 sessions (1 hour). Then, training is given to two pharmacology groups during 5 sessions (1 hour) during 5 weeks. At the end of 5 sessions among control and experiment groups, intrinsic cognitive load questionnaires are distributed. At the end of 5 sessions, learning of pharmacology was performed of two post-test groups. The collected data are analyzed by independent t-test and SPSS, version 18 software.

Cognitive and metacognitive strategies given to experiment group include cognitive strategies, repetition and review, semantic extension and organizing, metacognitive strategies including planning strategy, organizing, control and supervision. The measures of study include:

1- Learning test of pharmacology of nursing, learning test including pre-test and post-test as composed of 20 questions (four items) and its score is ranging 1-20 from pharmacology of nursing major. After validity verification of pre-test and post-test by lecturers regarding the experts, their reliability was computed via Cronbach's alpha on 5 students

not included in the study as 0.82, 0.79, respectively.

2- Intrinsic cognitive load questionnaires, this questionnaire has verified validity and reliability. The validity of this questionnaire is 0.83 (Zare, 2014). This questionnaire composes of 5 questions with 5-item Likert scale (Very simple, numerical value 1, simple, neither simple nor difficult, difficult, 3; very difficult 4). The minimum score in each question is 0 and maximum score 4 and totally minimum score is 0 and maximum score 20. This questionnaire is self-interpretive and is completed by subjects at the end of each session of training.

RESULTS

Descriptive statistic features of subjects are shown in Table 1.

First hypothesis: There is a significant difference between learning of experiment group learning pharmacology with cognitive and metacognitive strategies and control group training the same content without cognitive and metacognitive strategies. The results of independent t test for subjects are shown in learning in Table 2. As shown, there is no significant difference between pre-test scores of control and experiment group in learning amount ($t=0.133$, $p=0.567$).

As shown, post-test scores of control and experiment group in learning amount showed

significant difference ($p=0.001$, $t=4.93$). Based on the difference of scores in pre-test and post-test of learning two groups, we can say there is a significant difference between learning of experiment group learning pharmacology content with cognitive and metacognitive strategies and control group learning the same content without cognitive and metacognitive strategies.

Second hypothesis: There is a significant difference between intrinsic cognitive load of experiment group learning pharmacology with cognitive and metacognitive strategies and control group training the same content without cognitive and metacognitive strategies. The results of independent t test for intrinsic cognitive load in control and experiment groups are shown in Table 3.

As shown in Table 3, as calculated t ($t=14.27$) is bigger than p value 0.014 at confidence interval 95% ($\alpha=0.05$) and degree of freedom 28. Thus, statistically there is a significant difference between the mean difference of control and experiment group ($P>0.001$, $t=14.27$). Thus, the mean of experiment group in intrinsic cognitive load is less than that of control group, thus hypothesis of study is supported. There is a significant difference between intrinsic cognitive load on experiment group learning pharmacology with cognitive and metacognitive strategies and control group subjects learning

the same content without cognitive and metacognitive strategies.

Table 1- Descriptive feature of subjects

Cumulative frequency percentag	N	Level and major	Educational groups
50	15	BA of nursing	Control
100	15	BA of nursing	Experiment

Table 2- Independent t-test for control and experiment groups in pre-test and post-test in learning amount

P-Value	T	SD	Mean of scores	Groups	
0.567	0.133	1.30	9	Control	Pre-test
		1.28	8	Experiment	
0.001	4.93	1.47	11	Control	Post-test
		1.35	17	Experiment	

Table 3- Independent t-test for intrinsic cognitive load

P-Value	T	Df	SD	Mean	N	Group	Variable
0.001	14.27	28	1.30	17	15	Control	Intrinsic cognitive load
			1.39	10	15	Experiment	

DISCUSSION

The present study aimed to evaluate the impact of cognitive and metacognitive strategies learning on learning and intrinsic cognitive load of nursing students in pharmacology. The results of study regarding the first hypothesis of study (there is a significant difference between learning experiment group learning pharmacology with cognitive and metacognitive strategies and control group learning the same content without cognitive and metacognitive strategies). And it was shown that cognitive and metacognitive strategies learning to subjects increased learning in pharmacology. The findings of this study are consistent with the results of study of Maleki (2005), Malekian et al., (2010), Nasim et al., (2013),

Mohammadi Darvish Baghal et al ., (2013), Salehi et al., (2013) and Efklides (2011).

Also, results of study regarding the second hypothesis of stud y (there is a significant difference between intrinsic cognitive load on subjects of experiment group learning pharmacology with cognitive and metacognitive strategies and control group learning the same content without cognitive and metacognitive strategies) showed that training cognitive and metacognitive strategies to subjects reduces intrinsic cognitive load in pharmacology. The findings of this study are consistent with the results of study of Mosa Ramezani et al., (2013), Zare (2014) and Zare et al., (2015).

CONCLUSION

The result of study showed that training cognitive and metacognitive strategies to

subjects increased learning and decreased intrinsic cognitive load in pharmacology. Training cognitive and metacognitive strategies facilitated the learning for learners increased their learning. If an educational content has high content link, its education increases intrinsic cognitive load for learner but if cognitive and metacognitive strategies are used by learner, intrinsic cognitive load of content is managed and if intrinsic cognitive load is reduced, learning is increased. Thus, teaching cognitive and metacognitive strategies to learners increases learning and decreases intrinsic cognitive load in pharmacology.

The results of study showed that it is recommended to recognize cognitive and Meta cognitive strategies and teach it to learners. On the other hand, education experts can use these strategies during learning-teaching process.

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