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# The Effect of Critical Thinking on Metacognitive Knowledge and Epistemological Beliefs of High School Students

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**Abstract**

**Purpose**: The purpose of this study was to investigate the effect of teaching critical thinking on meta-cognitive awareness and epistemological beliefs of high school students.

**Methodology**: The present study was a semi-experimental study with pre-test, post-test and follows up with control group. The statistical population of this study was all second grade high school students in Zahedan. The sample consisted of 30 subjects who were selected by randomized cluster sampling and were randomly assigned to either experimental (15 subjects) or control (15 People). The data collection tool was a meta-cognitive awareness questionnaire by Schraw and Dennison (1994) and epistemological questionnaire (EQ) (Schumer, 1990, 1993). At first, subjects of both groups were pre-test and then the experimental group received 12 critical thinking training sessions. While the control group did not receive any intervention. For analyzing the data, covariance analysis was used by SPSS software.

**Findings**: The results showed that there is a significant difference between the mean scores of meta-cognitive awareness and epistemological beliefs in the experimental and control groups in the post-test (P <0.01). The effect of teaching critical thinking on metacognitive awareness and epistemological beliefs of students in the follow up phase has continued.

**Conclusion**: teaching critical thinking was effective on metacognitive awareness and epistemological beliefs of students. Teaching students to improve the effective use of abilities improve their performance and provide them with reasonable decision making and thinking.

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## 1. Introduction

The accumulation of a large amount of information in the universal mind is scientifically not credible, but what is important is a process of knowledge, control, and control over the mind itself for gaining knowledge and learning, which is in the domain of metacognition (Chon and Shin, 2019). Kuhn (1989) argues that learners, because they do not know how to use their meta-cognitive skills, have many problems in scientific reasoning, which can be rooted in their training in lower grades. Research by Baker (1982) (quoted by Huseyin, 2016) showed that the "study program", "learning strategies" and "monitoring the effectiveness of the strategies used" have an important impact on the learning process. They consider students' learning difficulties as a result of the weakness of their metacognitive awareness. Some educators define successful learning in terms of metacognitive knowledge and believe that metacognitive awareness makes learners more dependent on learning rather than relying on teachers (Buckert 1999, Quoted by Bernstein, Hadash and Fresco, 2019). From Biggs and More (1993), effective learning is achieved through engaging students in meta-cognitive processes such as planning, monitoring, and thinking about thinking. According to some researchers, this awareness can be trained and, if included in the curriculum, can have beneficial effects (Parsons et al., 1996; translation of Asadzadeh and Eskandari, 2006). But at the moment in school curricula, attention is not paid to metacognitive components (Levy, Kennis, Loll, 2019). Metacognition means identifying, controlling and controlling inner thinking, and organizing and evaluating inner cognition and thinking. Metacognition is to recognize how a concept is learned and understood and understood. Metacognition is a form of cognition, which is the process of high-level thinking and involves the active control and monitoring of cognitive processes (Hamonniere and Varescon, 2018). Metacognitive awareness is part of our knowledge of the world dealing with cognitive issues. Knowledge and beliefs we gained through experience and store in long-term memory. This knowledge is not affiliated with any specific content. It is related to mental activity (Yuksel, 2012).

Many studies have shown that the use of metacognition in class to improve general learning, and problem-solving learning, research and high-level thinking in particular (Zohar and Peled, 2008). Chon & Shin (2019) found that students who use meta-cognitive strategies are more successful learners in a study that examined the relationship between meta-cognitive approaches and student learning. One of the other factors influencing learner motivation is epistemological beliefs. The epistemological beliefs of individuals are related to the nature of knowledge and knowing how to form it. Educational scholars today believe that epistemological beliefs are both an important educational goal and a key predictor of learning progress (Trautwein and Ludtke, 2007). The most famous epistemological model is the Schumer model (quoted by Schommer, Duell and Hutter, 2005). In this model, epistemological beliefs consist of five dimensions of simple knowledge (knowledge as an inseparable component of each other), definitive knowledge (absolute and unchanging knowledge), learning ability (constant learning ability from birth), knowledge source Knowledge as the legacy of scientific references) and quick learning (acquiring quick knowledge).Previous research Bendixen and Hartley (2003); Whitemire (2004); Kardash and Howell (2000) reveal the relationship between epistemological beliefs and motivation and academic performance of learners. Liang, Lee and Tsai (2010) in their research on Taiwanese science students showed that students who believe that scientific knowledge is temporary and that they are derived from reasoning, experimentation and thinking have an intrinsic learning motive, a greater interest in acquiring science have. Tsai, Ho, Liang and Lin (2011) also concluded that students who believe that scientific knowledge is uncertain, have lower self-help than learning science. In cognitive theories, metacognition and constructivism are emphasized on the importance of teaching thinking and evaluation in teaching and learning. Practicing educational psychologists consider this important in teaching critical thinking (Yarmohammadi Vassil, Farhadi and Yaghobi, 2016).

The experts in the field of education and psychologists have provided many definitions of critical thinking. Zeki (2015) defines critical thinking as the art of analyzing and evaluating thinking, along with a

review for its correction. According to Emir (2009), seven components, which include curiosity, mind-breaking, regularity, analyticity, rationalization, self-confidence, and the search for truth, thinking skills Criticizes people, if people use critical thinking skills, they will gain deep and clear insights. Critical thinking, which is the process of reflection and reasoning, requires the individual to find out the situations, solve problem problems, and create a hypothesis and compilation of information through the process of questioning, lead to the development of results and justification for the conclusion. Critical thinking is used to solve problems, decisions, and inferences. Two reasons that arise from the need to teach day-to-day thinking, one is that thinking is an intrinsic part of human growth (Haynes, 2007), and the other is that man enjoys the correct stimulation and rational challenge. Abrami and colleagues argue that critical thinking or the ability to judge purposefully is self-disciplined and has been widely recognized as a basic skill in the knowledge age. They consider the role of critical thinking as important in big life, and believe that individuals with critical thinking ability have a greater chance of success and coordination in the social realm (Abrami et al., 2008).

Critical thinking is an active and skillful systematic process that involves analyzing, combining and evaluating information with the help of observation, experience, reflection, consideration, and communication. Critical thinking goes beyond the acquisition of knowledge and takes place at a higher level than thought. Developing critical thinking among learners is considered as one of the goals of higher education. The development of such thinking largely requires a rethinking of teaching methods. Unfortunately, many teacher-based teaching methods are not only critical to the development of student critical thinking, but also increase their willingness and dependence on teachers, leading to the problems of learning become worse (Lee and Boyle, 2012). Critical thinking helps students make difficult choices. In order to develop critical thinking, it is necessary to identify the existing situation and at the same time provide a suitable climate for the growth of thinking, their attitudes and their involvement in personal, social, family, school, and participation in thought and solutions (Gatman, 1995, quoted from Mahmoudi and Dehghannejad, 2015).

In recent years, research has shown that critical thinking can be trained for example, Zare and Nahrananian (2017); Yarmohammadi Vassil, et al (2016); In this regard, the results of the research have shown that critical thinking has an impact on epistemological beliefs Foulad Chang, Shirzadi, Hatami and Mirzaei (2016); Kamali Zarch, Zare and Alavi Langroudi (2012); Alavi Langroudi (2012). Some other studies have shown that there is a meaningful relationship between critical thinking and epistemological beliefs Tabatabai and Zare Shahsun (2016); Soleiman Nejad and Arimolvi (2012); Greene and Yu (2016).

Considering that in the teaching of critical thinking and its effect on improving metacognitive awareness and epistemological beliefs, there has not been a systematic and systematic framework for teaching about education, and most teachers use the same traditional methods as self-taught teaching materials They keep students' thinking about the progress of their thinking as reminders of content and do not think of them to the level of processing, evaluation, and hypothesis, in order to help students think and craft critical thinking skills, such as: Reasoning, evaluating

## 2. Methodology

The purpose of this study is to use a quasi-experimental study with a pretest and post-test design and follow-up with the control group. The statistical population of this study was all the second grade high school students in Zahedan. A sample of 30 individuals was selected through a randomized cluster sampling method in which 90 students were selected and filled out questionnaires. After completing the questionnaire, 30 students who scored low scores in meta-cognitive awareness and epistemological beliefs were selected as the sample and randomly assigned to two experimental groups (15 subjects) and control (n = 15).

Research tools: Meta-cognitive Awareness questionnaire, developed by Schraw and Dennison (1994) for measuring metacognitive awareness. This questionnaire has 52 items that measure metacognitive awareness dimensions. The components of the questionnaire include metacognition and metacognitive control. The score for the questionnaire is correct and the score is 0 and the score is zero. Shrv and Denison reported an internal consistency coefficient of 88-93% and a reliability coefficient of Cronbach's Alpha of 93%. In Delawarepur's internal research (2007), the correlation coefficient between components was obtained for the whole scale of 95% and the 90% reliability coefficient for the whole scale.

The epistemological questionnaire, which consists of 63 questions, has been widely used as a multifactorial construct to measure the epistemological beliefs of university students. The factors of this questionnaire are simple knowledge, certainty of knowledge, source of knowledge, inherent ability of learning and quick learning. In this questionnaire, respondents are asked to identify their opinion on each question in a Likert scale of four degrees from one (completely opposite) to four (fully agree). Some questions of the questionnaire are also scored in reverse order. High scores in each factor indicate the students' raw beliefs. Shomer set these 63 positions according to his theory in 12 classes. Then, based on factor analysis and using Varimax rotation, four main factors were extracted: 1. Fixed ability, 2. Simple knowledge, 3. Rapid learning, 4. Definitive knowledge. Pong and Fincher Gerald stated that the content validity of the epistemological questionnaire has been confirmed by the scholars of the educational psychology and its predictive validity as well as the various learning contexts. Duell and Schumacher Aikins (2001) reported a reliability coefficient of 0.74 using the method of re-examination and Cronbach's alpha coefficient for each of the factors of the questionnaire ranging from 0.63 to 0.58. Researchers conducted in Iran have shown the reliability coefficients for epistemological beliefs sub-scales ranging from 0.52 to 0.63.

Manner of execution: To conduct this research, 30 people were first selected and responded to the measuring instrument in two groups (experimental group and control group). Then the independent variable, namely, teaching critical thinking among the experimental group was applied and after the completion of critical thinking training sessions, the experimental group and the control group again responded to the measurement tool as a post-test. A month later, both groups were resumed. Prior to conducting satisfaction training, subjects were taken and can be discarded at any stage of the study. The training group has been emphasized that the contents of the training package are not defined to anyone until the implementation of the post-test. The training was carried out by a specialist who had completed workshops in this field at the girls' research school in Valiasr city of Zahedan. The number of treatment sessions for teaching critical thinking was 12. At each session, a brief summary of the discussions of the previous meeting was first discussed, and two sessions were then linked together. The treatment sessions were held once a week for a period of 1.5 hours. There was no drop in Aznodnians. Critical thinking training sessions are:

**Table1**. Description of Critical Thinking Teaching sessions based on the views of Hip Fischer and Maiszer(quoted by Zare and Nahroanian, 2017)

| sessions | Sessions content |
| --- | --- |
| First session | Welcome, Meet Participants and Talk about Group Program, Goals and Structure of Meetings, Group Rules, Introductory Thoughts on Thinking, Critical Thinking and Its Role in Decision-Making and Solving Daily Living Challenges |
| Second and third sessions | Analysis Skill:<br>- Analysis and discussion of topics and experiences<br>- Analysis of assignments and conversion of questions to small components<br>- Clearing the facts from the hypotheses<br>- Relationship analysis between the terms of a story<br>- Analysis of a process or general position to components<br>- View similarities and differences |

| | -Summarize and take notes |
|---|---|
| third session | Interpretation concept:<br>-Management of interpretation<br>-Interpreting experiences and rebuilding views |
| Sessions 4 and 5 | Concept of Valuation:<br>- Assessment skills<br>- Identification of criteria and criteria in evaluation and judgment<br>- Detect strengths and weaknesses<br>-Principles of logical judgment |
| Sixth and seventh sessions | Skill Inference and Understanding:<br>- Converting symptomatic symbols to spoken words<br>- Creating a logical relationship between new concepts and previous experiences<br>- Submission of perceived content abstractly and technically<br>-Inference from speech and audio |
| Eighth and Ninth Sessions | Skill explanation:<br>Draw a concept in the form of a whole<br>-Explaining the proper introduction to the subject<br>-Speech and its principles |
| Tenth and eleventh | Self-management skills:<br>- Understand yourself and your mental abilities<br>- The Role of Attitude in Individual Self-Confidence<br>-Collecting information by taking notes and summarizing<br>-Ask yourself<br>-self-appraisal |
| Conclusion-implementation of post-test | |

## 3. Findings

In order to test the research hypotheses, the covariance analysis test was applied using SPSS-22 software. In order to observe the assumptions of Covariance analysis, the assumptions of this test were examined and validated by using Shapiro-Wilk test and Lone test and tilt homogeneity regression test. Table 2 Descriptive statistics of metacognitive awareness and epistemological beliefs by group and test stage show:

**Table2.** Mean and standard deviation of pre-test and post-test scores Metacognitive awareness and epistemological beliefs in two groups

| Variables | group | number | pretest | | posttest | | Follow up | |
|---|---|---|---|---|---|---|---|---|
| | | | mean | standard deviation | mean | standard deviation | mean | standard deviation |
| Metacognitive awareness | experiment | 15 | 15/80 | 3/44 | 28/13 | 5/95 | 30/26 | 7/11 |
| | Control | 15 | 17/93 | 3/28 | 17/46 | 3/39 | 17 | 3/70 |
| Epistemological beliefs | experiment | 15 | 172/46 | 23/63 | 115/73 | 23/75 | 113/06 | 24/54 |
| | Control | 15 | 159/80 | 17/15 | 162/46 | 17/23 | 163/33 | 16/36 |

As shown in Table (2) the mean scores of metacognitive awareness in the experimental group in post-test and follow-up were increased compared to the pre-test and the scores of epistemological beliefs decreased while the mean scores of meta-cognitive awareness and epistemological beliefs in the control group There was no significant difference in pre-test, post-test and follow-up.

**Table3.** Shows the results of covariance analysis to examine the difference between the groups in metacognitive awareness and epistemological beliefs

| | posttest | Sum of squares | df | Mean square | F | Significance | eta |
|---|---|---|---|---|---|---|---|
| group | Metacognitive awareness | 994/364 | 1 | 994/364 | 3/40 | 0/001 | 0/661 |
| | Epistemological beliefs | 21446/692 | 1 | 21446/692 | 2/53 | 0/001 | 0/801 |
| error | Metacognitive awareness | 510/623 | 27 | 18/912 | | | |
| | Epistemological beliefs | 5338/342 | 27 | 197/715 | | | |

As shown in Table (3) there is a significant difference between the mean scores of meta-cognitive awareness and epistemological beliefs of participants according to group membership (experimental and control group) in the post-test (P <0.01). Therefore, teaching critical thinking on metacognitive awareness and epistemological beliefs has been effective. The effect of metacognitive awareness was 66.1% and epistemological beliefs were 80.1% in the post-test phase

**Table4.** Shows the results of single-variable covariance analysis on the metacognitive awareness and epistemological beliefs in two groups

| | posttest | Sum of squares | df | Mean square | F | Significance | eta |
|---|---|---|---|---|---|---|---|
| group | Metacognitive awareness | 1395/284 | 1 | 1395/284 | 4/030 | 0/001 | 0/661 |
| | Epistemological beliefs | 22751/239 | 1 | 22751/239 | 7/995 | 0/001 | 0/801 |
| error | Metacognitive awareness | 818/436 | 27 | 30/312 | | | |
| | Epistemological beliefs | 7978/219 | 27 | 295/490 | | | |

As shown in Table (4) there is a significant difference between the mean scores of metacognitive awareness and epistemological beliefs of participants according to group membership (experimental and control group) in the follow up phase (P <0.01). Therefore, the effect of critical thinking teaching on meta-cognitive awareness and epistemological beliefs has continued at the follow-up stage. The effect of metacognitive awareness was 63% and epistemological beliefs were 74% in the follow-up phase.

## 4. Discussion

The purpose of this study was to influence the teaching of critical thinking on meta-cognitive awareness and epistemological beliefs of high school students. Therefore, after performing this method and examining the results of pre-test, post-test and follow-up, it can be concluded that critical thinking training has been effective on metacognitive awareness and epistemological beliefs of students. Several studies have used Critical Thinking Education in different fields, and it has been considered as effective. It is possible to study Zare and Nahrananian (2017), Yarmohammadi Vassil et al (2016). According to Wallenstein et al. (2010), skills such as the tendency to think critically for proper performance in doing things alone are not enough. Individuals are taught to use critical thinking skills to be prepared. Metacognition supports the strengthening and development of critical thinking in the educational process. From the metacognitive point of view, students must be active in self-monitoring mental processes and adjust their mental activities (Gholamrezai, Yousef Vand and Radmehr, 2017).

Teaching students for their effective use of metacognitive ability improves their performance and provides them with reasonable decision making and thinking. Also, according to McMurray and Sanfr (2005), metacognition as an effective component in thinking involves awareness of personal thinking and learning, as well as controlling, evaluating and organizing the learning process. A learner who has developed metacognitive awareness about himself, homework, and strategies can enhance his ability to

learn and also his own self-actualization. The effect of meta-cognitive development, which follows with the growth of critical thinking and judgment and power, is effective in self-efficacy, in judging and criticizing individual abilities, and resulting in success, because the consideration of self-efficacy of one of the most important pillars of effort and effort for various successes, including scientific advancement.

The findings of this study indicate that critical thinking training is effective on epistemological beliefs of high school students. These findings are found in the researches by Foulad Chang, et al (2016), Kamali Zarch et al (2012), Alavi Langroudi (2012), Tabatabai and Zare Shahsun (2016), Soleiman Nejad and Arimolvi (2012) Greene and Yu (2016). The more epistemological beliefs of students are more complex, the knowledge that is coherent, non-deterministic, and being completed, and having a gradual learning process with time and effort, will have higher academic achievement. Therefore, there is a positive relationship between belief in conscience and the integrity of knowledge with academic achievement, which indicates that education can improve the belief in the lack of knowledge integrity and its growth towards the belief that unconscious knowledge is indeterminate and it is growing, it is affecting.

Each research has limitations that the present study is not an exception to. The limitations of this research can be generalizable, as well as the impossibility of controlling and measuring it after several months. Therefore, it is suggested that future research should be used as a follow-up step, and it is suggested that critical thinking skills be included among school curricula.

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