



Research Article

Investigation of Gifted Students' Epistemological Beliefs, Self-Efficacy Beliefs and Use of Metacognition¹

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Received: 07 August 2018 **Accepted:** 11 September 2018

Abstract

The aim of this study is to examine how well gifted students' self-efficacy beliefs and epistemological beliefs (justification, development and source/certainty) predict their metacognition use at solving science problem. For this purpose, Epistemological Beliefs Questionnaire, Motivated Strategies for Learning Questionnaire, and Metacognitive Activities Inventory were administered to 81 gifted students. Descriptive statistics and multiple regression analysis were conducted. Results showed that gifted students strongly believe that knowledge changes and critical examination of evidence causes construction of knowledge. They also believe that the source of knowledge is the learners themselves and there is more than one correct. Moreover, gifted students appear to be self-efficacious in science learning and they use metacognition at science problem solving. In addition, the gifted students who feel self-efficacious in science and who believe that scientific knowledge can change, and it is constructed via critically judging evidence and experts' opinions tend to use metacognition at higher levels while solving science problems. Based on these findings, some suggestions were made for teachers to be able to help students to use their metacognition more effectively in science classes.

Keywords

Gifted students, metacognition, self-efficacy, epistemological beliefs

To cite this article:

Ucar, F.M. (2018). Investigation of Gifted Students' Epistemological Beliefs, Self-Efficacy Beliefs and Use of Metacognition. *Journal for the Education of Gifted Young Scientists*, 6(3), 1-10. DOI: <http://dx.doi.org/10.17478/JEGYS.2018.77>

¹ This study was presented as oral presentation at the 10th World Conference on Educational Sciences. (WCES-2018). Prague, Czech Republic, 2018.

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Introduction

Nowadays, gifted students and their needs in the educational process have gained great importance around the world, because enhancing their potentials to the highest possible level has been seen as a social requirement of a country (Trna, 2014).

Actually, gifted students possess high potential to succeed in many areas; however, emergence of this potential depends on various factors such as non-cognitive personality factors (i.e., motivational characteristics) and environmental factors (i.e., parents' socioeconomic status and stimulation; teaching methods, teachers' orientation toward learning, education policy about gifted students including education of their teachers) (Vlahovic, Vidovic & Arambasic, 1999). In other words, it is easy to think that gifted students will use metacognitive skills and will be successful at school, because- by definition- they are able to think, understand and learn topics more rapidly and easily than their peers, as well as metacognition and giftedness have been seen as closely linked (Barfurth, Ritchie, Irving & Shore, 2009; Patrick, Gentry & Owen, 2006). However, students do not always use metacognitive skills on a regular basis (Bandura, 1993) because their motivational characteristics and some beliefs also have a critical role on their use of metacognition (Barfurth, Ritchie, Irving & Shore, 2009).

For example, epistemological beliefs are seen as one of the ways to comprehend the structure of metacognition process (Muil, Hussin, Mamat, Mohamed & Zailani, 2013) and there are some research implying that there is a relationship between epistemological beliefs and use of metacognition (Hofer, 2004; Kitchener, 1983; Schommer, 1990). Similarly, it is also stated that students' beliefs about the nature of knowledge are significant at learning, problem-solving, and making conclusions Schommer (1994). Moreover, several studies indicate that gifted students, who use metacognitive strategies, possess more sophisticated beliefs about the nature of knowledge (Schommer & Dunnell, 1994; 1997; Schommer & Neber, 2002).

In addition, as Barfurth and his colleagues (2009) stated, metacognition cannot be isolated from the mediating effects of motivation, interest, affect, and self-efficacy. Actually, most of the findings of the studies showed that students' self-efficacy beliefs have an effect on students' use of metacognition; that is, students who have strong self-efficacy beliefs, are inclined to use metacognitive strategies when working on a task (Bouffard-Bouchard, Parent, & Larivee, 1991; Kanfer & Ackerman, 1989). In addition, it is also reported that students who use metacognitive strategies effectively also have strong belief in their capabilities to successfully perform a task Coutinho (2008). Similarly, Bandura and Wood (1989) indicated that there is a mediating effect of metacognition in the relationship between self-efficacy and performance.

Gifted students are able to think and learn topics more rapidly than their peers, and they want to ask many further questions such as “why?” or “how?” Unfortunately, regular classrooms fail to answer these questions effectively (Hébert & Neumeister, 2000). Therefore, these students get bored and become lost in such classroom environments (Gadanidis, Hughes & Cordy, 2011). To solve this problem and support their learning, it is important to understand the development of intellectual abilities and talents (Barfurth et al., 2009). Thus, metacognition and predictors of metacognition become more important to understand giftedness and to support their learning.

There are many studies on student metacognition and its relationships between some motivational characteristics such as motivational beliefs, goal orientations, task value; and some intellectual skills such as cognitive skills and problem-solving skills; and epistemological beliefs. However, any study relating to contribution of self-efficacy beliefs and epistemological beliefs to use of metacognition has not been found in the literature reviewed. Moreover, previous researches mainly focus on regular students; however, there is need for investigating gifted students' metacognition in relation to some student characteristics because giftedness is closely related to metacognition. Therefore, the present study was conducted with gifted students. Additionally, most of the studies relating to this issue were conducted in Western countries. However, there is need for understanding this issue in different cultures and countries to be able to make the results generalizable across different cultures and countries (Kahraman & Sungur, 2011). Thus, this study was conducted with Turkish students. For these reasons, this study can be considered as important.

In the light of the findings of the studies mentioned afore, the purpose of this study is to examine the contribution of gifted students' self-efficacy beliefs in science and epistemological beliefs to the prediction of their metacognition use in science problem solving. Accordingly, the following research questions guided this study:

- To what extend could gifted students' use of metacognition be predicted by epistemological beliefs and self-efficacy beliefs?
- Which is the best predictor of gifted students' use of metacognition: epistemological beliefs or self-efficacy?

Method

Sample

A total of 81 gifted students (45 girls, 36 boys) from two Science and Art Centers in two different cities in Turkey participated in this study. It is also important to note that Science and Art Centre is an educational institution for gifted students in Turkey. In these centers, students are identified as gifted based on the results of some internationally validated tests.

Table 1.*Frequency and Percentage of Sample in Terms of Gender and Grade Level*

| | Variable | Frequency (f) | Percentage (%) |
|-------------|-----------------|---------------|----------------|
| Gender | Male | 36 | 44,4 |
| | Female | 45 | 55,6 |
| Grade Level | 4 th | 14 | 17,3 |
| | 5 th | 20 | 24,7 |
| | 6 th | 26 | 32,1 |
| | 7 th | 17 | 21,0 |
| | 8 th | 4 | 4,9 |
| Total | | 81 | 100 |

Instruments**Epistemological Belief Questionnaire (EBQ)**

It is an instrument included 5-point Likert scales developed by Conley, Pintrich, Vekiri and Harrison (2004) to assess students' epistemological beliefs. The EBQ was translated and adapted into Turkish by Ozkan (2008). It includes 24 items in three subscales which are namely justification (9 items) (e.g. "Good answers are based on evidence from many experiments"), source/certainty (9 items) (e.g. "Whatever the teachers says in science class is true./ All questions in science have one right answer"), development (6 items) (e.g. "Sometimes scientists change their minds about what is true in science"). Cronbach's alpha coefficients were found as .70 for justification, .88 for source/certainty, and .71 for development, the values of which suggest the instrument had adequate internal consistency.

Metacognitive Activities Inventory (MCA-I)

It was developed to measure students' level of metacognition use in problem solving by Cooper, Urena and Stevens (2008). It was adapted into Turkish by Tuysuz, Karakuyu and Bilgin (2008). It consists of 27 items (e.g. "I read the statement of a problem carefully to fully understand it and determine what the goal is") on a five-point likert scale. Cronbach's alpha coefficient was found to be .85 for this scale, a value suggesting high internal consistency.

Motivated Strategies for Learning Questionnaire (MSLQ)

The questionnaire was originally developed by Pintrich, Smith, Garcia and McKeachie (1991) and adapted into Turkish by Sungur (2004). Self-efficacy for learning and performance subscale of this questionnaire was used for this study. The subscale consisted of eight items (e.g. “*I believe I will receive an excellent grade in the science class*”). It was a seven-point Likert scale. Cronbach’s alpha coefficient was found to be .84 for the self-efficacy for this subscale, value of which suggests high internal consistency.

Results**Descriptive Statistics**

Descriptive statistics was used to determine the gifted students’ level of self-efficacy, epistemological beliefs and metacognition use. Mean and standard deviation of gifted students’ epistemological beliefs, metacognition use, self-efficacy are presented in Table 2.

Table 2.*Descriptive Statistics*

| Variables | M | SD |
|-------------------|----------|-----------|
| Justification | 4.41 | .42 |
| Source/Certainty | 3.73 | .89 |
| Development | 4.23 | .54 |
| Self -efficacy | 6.31 | .68 |
| Metacognition use | 3.84 | .55 |

As shown in the Table 2, mean scores for justification and development subscales are quite high and source/certainty is also above the mid-point of a five-point likert scale. This implies that gifted students strongly believe that knowledge changes and critical examination of evidence causes construction of knowledge. They also believe that the source of knowledge is the learners themselves and there is more than one correct. Moreover, gifted students appear to be self-efficacious in science learning and they use metacognition at science problem solving.

Inferential Statistics

As an inferential statistics, multiple regression analysis was conducted to determine the significant predictors of metacognition use at science problem solving. Therefore, metacognition use was determined as the dependent variable, while the

others (justification, source/certainty, development and self-efficacy) were determined as the independent variables (predictors) of this study. Before the data analysis, assumptions of the multiple regression (multicollinearity, outliers, homoscedasticity, normality, linearity, independence of residuals) were checked. There was no contravention of the assumptions.

Multiple linear regression analysis showed that the linear combination of four predictors; justification, source/certainty, development and self-efficacy were significantly related to gifted students' metacognition use ($F(4, 76) = 18.52, p < .05$). In other words, approximately 49% of variance in metacognition use could be accounted by the linear combination of these significant determinants ($R^2 = .49$).

More specifically, each contribution of the justification, development and self-efficacy was found statistically significant to the prediction of gifted students' metacognition use in science problem solving ($p < 0.05$), while source/certainty didn't make a significant unique contribution to the prediction of metacognition use ($p > 0.05$). About these significant variables, it was found that justification made the strongest contribution ($\beta = .53$), followed by self-efficacy ($\beta = .34$), and then development ($\beta = .30$). In other words, justification uniquely explains 23% of the variance in metacognition use scores, while development explains 11%, and self-efficacy explains 8% of the variance in metacognition use scores. Beta coefficients, significance values, semi-partial correlation coefficients, and squared semi-partial correlation coefficients are presented in Table 3.

Table 3.

Results of MRA regarding the Prediction of Metacognition Use

| Predictor Variables | β | p | sr | sr ² |
|---------------------|---------|-----|------|-----------------|
| Source/Certainty | -.01 | .24 | -.10 | .01 |
| Justification | .53 | .00 | .48 | .23 |
| Development | .30 | .00 | .33 | .11 |
| Self-efficacy | .34 | .00 | -.28 | .08 |

Accordingly, results imply that gifted students who believe that scientific knowledge can evolve as well as it is constructed by judging evidence and experts' opinions critically, use metacognition more effectively while solving science problems. Similarly, gifted students, who possess higher levels of self-efficacy in science use more metacognition at problem solving in science.

Discussion and Conclusion

The current study investigated the relationship between gifted students' beliefs (self-efficacy and epistemological) and their metacognition use in science problem solving. Findings revealed that gifted students' self-efficacy beliefs and sophisticated beliefs about justification and development significantly predict their metacognition use at science problem solving. This finding indicated that students who have high self-efficacy in science and who believe that knowledge is relative, uncertain, contextual, changeable and flexible, and thus it can be constructed actively by the individual are likely to use metacognition while solving science problems (they are aware of the requirements of the problem and they make plan, monitor and revise the problem). Related literature also revealed similar results about effects of self-efficacy on the metacognition use. For instance, Kahraman and Sungur (2011) demonstrated that elementary students' self-efficacy beliefs significantly predict their metacognitive strategy use in science classes. Similarly, several studies (i.e., Bouffard-Bouchard et al., 1991; Pajares, 2002; Pajares & Schunk, 2001) reported that students' self-efficacy is significantly linked to metacognitive strategy use. Thus, it can be deduced that if students believe that they can learn science successfully (self-efficacy is improved), then they can effectively use metacognition when solving science problems. Accordingly, to increase students' metacognition use, it is recommended that teachers should endeavor to progress students' judgments about their skills to complete science tasks. In order to accomplish this, they should make materials, activities and tasks useful, interesting, relevant, and acquainted for students (Ucar & Sungur, 2017). In addition, they should value original ideas and creative thinking in science class and should support students to engage in activities and discussions (Hidiroglu, 2014). Moreover, the challenge level of these tasks and materials should be set at optimum level, because students should be able to experience successes in learning to increase their self-efficacy (Kiran & Sungur, 2012). Finally, autonomy-supportive learning environments should be created by means of identifying and satisfying students' needs; getting their opinions; considering their interests, feelings, and preferences (Jang, Reeve, & Deci, 2010).

In addition, beliefs about justification and development significantly predict students' metacognition use in science problem solving. More specifically, this study revealed that gifted students who believe that knowledge is evolving (i.e., development) use more likely to metacognition in problem solving. The current study also indicated that gifted students who believe in the role of evidence and support the idea that knowledge comes from thinking, reasoning and experimenting (i.e., justification) tend to use metacognition in problem solving. These results are in agreement with the related literature partly. That is, most of the studies (i.e., Hofer, 2004; Ryan, 1984; Schommer, 1990) has been confirmed the relationship between epistemological beliefs and metacognition. For example, Hofer and Pintrich (1997)

explained this relationship by stating, “If one believes that knowledge is simple, then there is no reason to attempt to use deeper processing strategies such as elaboration; simple memorization will suffice” (p.128). Therefore, it was also expected that students’ sophisticated beliefs about source/certainty also predict their metacognition use. However, this study showed that students’ beliefs about that the knowledge is constructed by the learner and more than a single correct knowledge is possible did not predict their metacognition use. This may be resulted from the difference between gifted students and regular students, because aforementioned studies were conducted with regular students and information about gifted students was limited. Additionally, most of these studies did not mention about which belief is the best predictor of metacognition, rather they investigated this relationship by addressing epistemological beliefs as a whole. Therefore, it is recommended that further studies could be conducted to determine the role of each dimension of the epistemological beliefs as a predictor of gifted students’ metacognition use.

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