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The Effectiveness of Meta-Cognitive Education on Ten Teaching-Learning Strategies of Male Gifted Students in Ardabil's High Schools

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Abstract

The purpose of this study was to determine the effectiveness of meta-cognitive education on teaching-learning strategies of gifted high school students in Ardabil city. This quasi-experimental study was conducted considering two groups: one control group and one experimental group, including a pretest and a posttest design. The sample of the study consisted of 40 students of Ardabil city in 2017. The 40 students were selected from the community using random sampling method and were randomly divided into two groups: one experimental group and one control group (20 people in each). Pre-test and post-test were performed by Weinstein teaching-learning strategies, for both groups. The experimental group was trained by the meta-cognitive training program and the control group did not receive any training. Pre-test and post-test results were analyzed using inferential statistics and Multivariate Analysis of Covariance (MANCOVA). Findings showed that meta-cognitive training enhances teaching and learning qualities, also the effectiveness of meta-cognitive training on most components of teaching-learning strategies including test and information processing strategies, attitude, motivation, time management, self-testing, study guidance and effective focus was crystal clear. Although the status of these components improved in the experimental group, but was meaningless on the anxiety components and the choice of the main idea.

***Keywords*:** Gifted students, meta-cognitive education,teaching-learning strategies,

Introduction

Students' academic performance is one of the most important indicators in the evaluation of education, and all of the efforts of the education system are to support this issue. Academic performance means increasing the level of learning, increasing the level of grades and increasing the students passing rates in basic subjects (Saif, 2013).

Educational progress has always been the focus of educational researchers as a vital element in training process. People's potential for learning varies and, under the same conditions, they learn differently; the most important reason of this is different learning strategies and distinct control resources. According to educational theorists, in addition to the cognitive and emotional prerequisites for each learning task, learners' mastery of appropriate learning strategies and their use is an essential component of the learning process (Mesrabadi & Erfaniadab, 2013). In the last few decades, the worldwide attitude about the teaching and learning process has been changed and it is no longer believed that students' minds are like empty containers waiting to be filled with knowledge and information. In the current era, known as the Information Explosion Age, it is not enough to provide a set of information and concepts by schools' staff, and students must make out how to learn the various subjects, such as science, in order to be able to solve the problems that they deal with on a daily basis (Rayson et al, 2018).

Weinstein, Husman and Dierking (2000) considered learning strategies to include any thoughts, behaviors, beliefs, or feelings that facilitate the acquisition, understanding, and transferring of new

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knowledge and skills. Meta-cognitive skills guide and control learning processes (Van der Stel & Weenman, 2014).

According to Zimmerman (2001), learning strategies are explicit and hidden information processing activities that are used when encoding by learners to facilitate the acquisition and correct the retrieval of previously learned information. Since the intellectual skills and mental strategies that students use in their studying and learning procedure are teachable and learnable, so students' learning and studying strategies can be modified through educational plans (Umbach, 2002).

Contrary to what was once thought to be an individual's learning ability as a function of their intelligence and aptitude, it has recently been suggested that despite the intrinsic role of intelligence and learning aptitude, other non-intrinsic factors play roles. One of these non-intrinsic is meta-cognitive strategies (Maleki, 2005). Researchers have shown that among the 330 effective factors on learning, cognitive and meta-cognitive processes have the most impact on students' learning and academic achievements (Mahboobi & Mostafaei, 2006).

Cognition is the internal mental processes and the mean by which we consider, understand and encode the information and store it in memory, and retrieve and use it from memory whenever we need it (Bilere & Snowman as mentioned in Seif, 2013). Meta-cognition is to know the cognition or understanding the knowledge. More precisely, meta-cognition is a person's knowledge of how he himself or she herself is (Slavin, 2008). Meta-cognitive knowledge consists of three types of knowledge: the learner's own knowledge, such as awareness of his or her preferences, studying habits, goals, and strengths and weaknesses; knowledge of the task or subject of learning, such as information about the level of difficulty of the subject of learning; and knowledge about the amount of effort required to learn it and learning strategies and how to use them correctly (Saif, 2013). Meta-cognition is one of the components of operative functions that is particularly important in the social and educational readiness of children to enter the school (Semrud-Clikeman, et al, 2010).

Meta-cognition is a multidimensional concept that includes knowledge, processing, and strategies that assess, monitor, or control cognition (Spadaa et al., 2007). Three important meta-cognitive bases link new knowledge to previous knowledge, conscious choice of thinking strategies and planning, and monitoring and evaluating the thinking process (Blakey, Spence & Sheila, 1990). Meta-cognition has two main components, which include meta-cognitive knowledge and meta-cognitive skills (Borkowski, Chan & Muthu Krishna, 2000). Flavell (1988) referred to meta-cognitive knowledge and mentioned its three components: one's knowledge of her/his own cognitive system (Swanson, 1990), one's knowledge of the task (Kar & Joyce, 1998), and one's awareness of the strategies (Kadivar, 2004).

In fact, meta-cognition is a form of cognition that monitors cognitive processes (Kocak & Boyaci, 2010). Meta-cognition is one of the most effective predictor components of complex tasks (Weenman, 2010). Alsey (2012) found that meta-cognitive awareness can predict academic achievements. Emily et al. (2017) showed that bias index is the best measure of meta-cognitive monitoring to predict academic achievements, so children are able to perform their working memory as meta-cognitive monitoring which is associated with their academic achievements. People with more advanced meta-cognitive skills are also better at problem solving and critical thinking (Sengul & Katranci, 2012). When students become aware of their learning processes can better enhance their meta-cognitive strategies (Connor, 2007).

Also, Soleimani et al. (1977) concluded that providing intervention based on cognitive and meta-cognitive training strategies has been effective in improving information processing; therefore, they have suggested the use of these interventions. Research by Hong, O'Neill, and Peng (2016), entitled "The effect of explicit meta-cognition and motivational meta-cognitive instruction on creative performance" showed that there was a significant relationship between learning strategies and meta-cognitive activities.

There are a limited number of factors which are available for teachers and schools to improve the students' academic achievements. For example, parental intelligence and child's social status and parents' level of education are related to uncontrollable and non-interfering factors; but teaching meta-cognitive strategies would be effective for all students who have acquired cognitive skills. According to Venman and Spaans (2005), both intelligence and meta-cognitive skills are decisive in academic performance, but nonetheless, the meta-cognitive skills appear to be more likely to change and improve during the school years (Attar Khamene & Seif, 2009). Van Dyer-Stel and Venman (2014) found that the development of the quantity and quality of meta-cognitive skills in adolescents (12–15 years old) is remarkably rapid. However, the meta-cognitive skills development chart is not uniform and seems to be temporarily down at age of 15. According to Weil et al. (2013), meta-cognition is the ability to reflect our

thoughts and behaviors; however this meta-cognitive ability develops dramatically in adolescence, because its development during this period is related to the emergence of self-consciousness and self-awareness. Naturally, meta-cognitive ability is to increase significantly with age.

Students' learning capacities are different. The reason to assign special schools to gifted students who have a relatively high level of intelligence and academic ability is their willing to compete with each other in an effort to learn better and more efficient and to succeed; although to offer them the opportunity to deepen their learning. Therefore, the content of the courses and teaching methods in these schools should be more varied than the regular curriculum in state schools. Evidences suggest that meta-cognitive teaching is one of the methods that can be effective in educational settings such as governing the gifted students' schools (Gallagher, 1993). The gifted students who are surveyed in this study are admitted to these schools on the basis of annual entrance exams; it seems that they have high academic intelligence and aptitude and need to fine-tune their learning strategies in an effort to learn better and more effectively, also they need to acquire more skills to achieve more academic successes.

A study in Hong Kong showed that the Learning and Studying Strategies Inventory (LASSI) can be used as a suitable tool by students and educational staff to improve and develop reading and learning skills (Kwong, Wong & Downing, 2009). Schottz's study showed that this questionnaire can be used as a diagnostic tool to help teachers preparing students for professional proficiency tests (Schottz & Dalton, 2013). He then used this questionnaire to review and improve the studying strategies of first-year students, giving feedback to individual students, thereby helping to improve their studying methods (Haught, Hill, Waltz & Nardi, 1998).

The study of the theoretical foundations shows that meta-cognitive education can lead to better learning and improve academic performance. Students can be taught meta-cognitive strategies, and it might help them to become more conscious of their learning and thinking; so in light of the theoretical background of the research, we are looking to find out if meta-cognitive training affects the teaching-learning strategies of intelligent students?

Method

This study was a quasi-experimental study which was held in two groups (one control group and one experimental group) with pre-test and post-test procedure.

Participants

The statistical population consisted of Ardabil high school boys, in 2017, including 4 classes and 127 students who had accepted into these schools through national entrance exam. 40 students from this community were selected by simple random sampling and were randomly divided into two groups: experimental group and control group (20 people in each group).

Instruments

The questionnaire, which was developed by Weinstein and Schultz in 1987, was used to measure students' awareness of their studying strategies, and has designed to provide information on students' attitudes and learning abilities; the questionnaire contains 80 questions in 10 domains including, choice of main idea, test and information processing strategies, anxiety, attitude, motivation, time management, self-examination, studying guides, and learner's ability to focus in case of learning (Weinstein, & Schultz, 1987). Since the questionnaire is a diagnostic tool for identifying learning problems in ten distinct domains, the total score is not calculated. The questionnaire takes an average of 20 minutes to be completed; research subjects are adjusted by marking on a five-point Likert scale of questions ranging from "not at all true to me" to "totally true to me". Since each question has five choices, gets a score of 1 to 5; however half of the questions, considering the positive or negative nature of the question, get a score of 1 to 5, and the other half gets the score of 5 to 1. Thus, the range of scores in each domain is from minimum of 8 to maximum of 40 (Khadivzadeh et al., 2004). This questionnaire is a national norm based on samples of twelve different institutions in different geographical contexts. Currently 2247 educational institutions use this list. Weinstein achieved a reliability coefficient of 0.77 for this list. Zahedi and Fakhri (2015) also obtained a reliability coefficient of 0.89 after translating the list into Farsi and reviewing it.

The meta-cognition training program lasted for eight 120-minute sessions; also each test session included: 1) Motivating Students in: expressing purpose, interacting with students, explaining the importance of familiarity and applying these strategies. 2) Training Tutorials and Repetition Strategies: simple repetition and retelling, copying and summarizing topics, highlighting the key points, taking notes, repeating learner contents, transcribing difficult

contents, and practicing recounting for other people. 3) Semantic Explanation Strategies: creating analogs, using algorithms and taking notes, applying previous knowledge and personal experiences to create meaningful new effective information, trying to apply a strategy to solve the problem in the new situation. 4) Organizing Strategies: providing a framework for facilitating the coding, recalling and organizing the information and classifying the provided data by common features, networking, highlighting key ideas, focusing attention, allocating the resources, and applying the resources. 5) Designing: determining goals, time management, and selective attention and readiness for applying learning strategies, sequencing and scheduling learning activities, focusing selectively on goals and having purposeful learning strategies to achieve the goals, analyzing the tasks and selecting appropriate strategies. 6) Self-Monitoring: offering technics to control the efficiency of learning activities, modifying the applied strategies, stopping the study to select appropriate restorative strategies. 7) Self-Assessment: assessing the quality of learning outcomes after completing the task, evaluating the applied learning processes, evaluating the goals and evaluating and re-evaluating the results, assessing the individual's level of understanding. 8) Repeating and reviewing: what has been said, practiced, fixed, and finally summarizing the content of all reviewed issues during the sessions.

Procedure

Before implementing the educational program, groups were tested by a teaching-learning questionnaire, the experimental group received meta-cognitive training and the control group received no training.

The data about 20 students in the control group and the data about 20 students in the experimental group were analyzed; the average standard deviation was used to descript the analysis of the data and Multivariate Analysis of Covariance (MANOVA) was used to determine the effectiveness of meta-cognitive education interventions. The Learning and Studying Strategies Inventory (LASSI) was used in order to collect data in two stages before and after the training.

Findings

The mean age of male students in this study was 16.4 years. These 10^{th} grade students were educated in special school for gifted students and their educational status was above average (good and excellent).

Table 1.
Pre-test and Post-Test Scores in 10 Areas of Teaching-Learning Strategies

Method		anxiety	Attitude	Focus	Data analysis	Motivation	Self-evaluation	Choosing idea	Studying guide	Time management	Test strategies
Control	Pre test	20/30 7/78	21/99 7/30	19/90 7/44	24/40 7/25	23/60 6/41	23/50 5/04	27/03 4/81	23/55 5/48	20/30 5/70	21/35 4/73
	Post test	21/70 8/37	21/62 7/005	18/60 7/01	25/60 7/40	22/05 4/74	20/85 5/24	26/75 4/74	21/25 6/35	19/65 5/87	22/05 5/02
Experiment	Pre test	21/80 5/63	22/70 5/47	21/50 5/48	24/55 5/48	21/90 5/23	22/50 5/64	25/91 6/99	21/75 4/64	22/00 5/98	23/95 6/64
	Post test	29/50 6/25	33/15 5/90	30/95 6/15	30/35 6/72	29/85 5/73	29/05 7/40	32/30 5/92	28/80 6/27	30/30 5/60	32/50 5/78

Research hypothesis: meta-cognitive education is effective on teaching-learning strategies of gifted students. Multivariate analysis of covariance has been used to test the hypothesis. Table 1 shows the status of the subjects' scores in the pre-test and post-test in the 10 domains of teaching-learning strategies. Lambda Wilks test, at the significant level of $P < 0.05$, indicates that the scores of the components of teaching-learning strategies are significantly different between the experimental and control groups, Leven's test results show components of teaching-learning strategies with significance level of greater than 0.05, that the dependent variance is the same between groups and does not violate the homogeneity of the variances; Box's value is 256/604 and significance level is greater than 0.01 which indicates that the data doesn't violate the same assumption of variance-covariance matrix; also to investigate homogeneity of regression and lack of interaction of groups with pretest scores, same regression slope assumption has being considered.

In table 2, Multivariate Analysis of Covariance, MANCOVA, was used to examine the effectiveness of problem solving on the components of teaching strategies between the experimental and control groups, and was confirmed based on the results of this assumption. The results showed that the scores of the effectiveness of meta-cognitive training, in the majority of the components of teaching-learning

strategies (except for anxiety and choosing the main idea) in the experimental group, have improved considerably.

Table 2.
Multivariate Analysis of Covariance, the Effectiveness of Meta-cognitive Education on teaching-learning strategies

		Sumof squares	Degrees of freedom	Average of squares	F	The significance level	Split squares
Group	Processing data	180/00	1	180/00	3/952	0/050	0/049
	Choosing the main idea	98/370	1	98/370	3/553	0/052	0/038
	Test strategies	1051/250	1	1051/250	35/331	0/001	0/317
	Anxiety	168/200	1	168/200	2/910	0/092	0/037
	Attitude	632/902	1	632/902	15/295	0/002	0/168
	Motivation	259/200	1	259/200	9/948	0/003	0/116
	Focus	973/013	1	973/013	22/569	0/000	0/229
	Self-assesment	423/200	1	423/200	11/547	0/001	0/132
	Studying guide	266/450	1	266/450	7/622	0/007	0/091
	Time management	762/613	1	762/613	22/720	0/000	0/230
Pre-test interaction effect (regression slope)	Data processing	73/697	2	36/849	1/180	0/319	0/060
	Choosing the main idea	122/856	2	61/428	1/946	0/157	0/095
	Test strategies	136/798	2	72/899	2/966	0/112	0/091
	Anxiety	301/830	2	150/915	2/583	0/089	0/122
	Attitude	254/760	2	132/880	2/101	0/091	0/115
	Motivation	231/124	2	128/062	2/021	0/095	0/119
	Focus	300/645	2	150/81	2/128	0/089	0/123
	Self-assessment	200/941	2	100/471	2/047	0/143	0/100
	Studying guide	232/038	2	116/019	2/176	0/096	0/120
	Time management	195/428	2	97/714	2/476	0/105	0/101
Error	Data processing	180/00	1	180/00	3/952	0/050	0/049
	Choosing the main idea	98/370	1	98/370	3/553	0/052	0/038
	Test strategies	1051/250	1	1051/250	35/331	0/001	0/317
	Anxiety	168/200	1	168/200	2/910	0/092	0/037
	Attitude	632/902	1	632/902	15/295	0/002	0/168
	Motivation	259/200	1	259/200	9/948	0/003	0/116
	Questions' focus	973/013	1	973/013	22/569	0/000	0/229
	Questions' self-assessment	423/200	1	423/200	11/547	0/001	0/132
	Studying guide	266/450	1	266/450	7/622	0/007	0/091
	Time management	762/613	1	762/613	22/720	0/000	0/230

Discussion and Conclusion

The purpose of this study was to determine if meta-cognition education affects teaching-learning strategies of gifted high-school students in Ardabil.

The results showed that meta-cognitive education affects the components of teaching-learning strategies (including: information processing, test strategies, attitude, motivation, and focus on questions, self-examination, studying guide and time management) in gifted high-school students, but the anxiety and choice component has no effect. Effectiveness of meta-cognition on the components of teaching-learning strategies other than anxiety and choosing the main idea is consistent with the findings of Sergolzaei et al. (2018), Rahimi et al. (2018), Soleimani and Ashoornezhad (2013), Noohi et al. (2012), Alibakhshi and Zare (2011), Sepehvand et al. (2016), Panadero (2017), Emily et al. (2017), Tolar et al. (2016), Cornoldi et al. (2015), Swanson (2015), Swanson and Stomel (2012), Goldfus (2012), Jean Lingo Lee (2012), Bunker (2010), Erdogan et al. (2010), Gordon (2009), Weinstein and Hume (1998), Attar Khamene and Seif (2009), Kaskan (2010), Sadeghi (2010), Khaksar and Seif (2008), Mousavinazhad (1997); however the results are against the findings of Lavasani et al. (2013), Tabatabai et al. (2012) and Williams et al. (2002).

For example, Soleimani et al. (2018) and Yarmohammadian et al. (2015) found out that teaching cognitive and meta-cognitive strategies improves and speeds up students' information processing. In fact, a

high percentage of students with learning disabilities have poor performance in information processing. According to the psychological approach to information technology, any tool that helps processing the information actually helps learning and remembering process. Many studies show that learning impairment is related to how the brain processes the information and is in relation with the cognitive facts (Swanson, 2015; Swanson & Stomel, 2012).

Meta-cognition education does not influence choice of the main ideas via intelligent students, which is inconsistent with the findings of Mousavinezhad (1997) and Gordon (2009). For example, Gordon (2009) showed in a study that students who have not failed in any of the previous semesters have better understanding of the main ideas of the contents and they process the information more favorably and to a greater extent through self-test and test strategies. Mousavinezhad's (1997) research showed that using cognitive strategies such as trying more about the problem, selecting goals, and challenging tasks was more common than ordinary learners among the intelligent students. In explaining this finding, it seems that the smarter students have a high level of competitiveness to gain acceleration over their competitors, and learning strategies which are inconsistent with this acceleration and competition is less likely to be of interest to these intelligent students.

The findings of Khaksar and Seif (2008) as well as Atkins and Nouriner (1974) also imply the effectiveness of test strategies. In their studies, they found that meta-cognitive training affects learning skills. The findings of Sadeghi (2010), Jen, Lingoli (2012), and Erdogan et al. (2010) also indicated the effect of meta-cognitive education on students' attitudes. The impact of meta-cognitive education on the "attitude" component of gifted students is achieved through introspection and regular practice, commitment, positive and individual attitudes toward learning and accuracy (meta-cognitive elements). In this way, gifted students develop their own insights into their own thinking and develop independent learning abilities (Sadeghi & Mohtashami, 2010).

In the present study, meta-cognitive training did not affect the anxiety of gifted students. This was not in line with the findings of Lavasani et al. (2013), Sargolzaei et al. (1397), Tabatabai et al. (2012), Khaksar and Seif (2008), and Williams et al. (2002). That is, the results of Williams et al. (2002) showed that one of the meta-cognitive factors that influence students' quality of learning is anxiety, stress, cognitive and meta-cognitive irrational beliefs, and fear of not being able to do homework or assignments. However, the reason that meta-cognitive training did not have an impact on reducing the anxiety of these gifted students was probably due to the high volume of these students' assignments and the closeness of the end-of-semester examinations at the time of this study and the intense competition among these students.

Findings of Gadampour et al. (2018), Ashournezhad (2013), Bedi et al. (2012), Noohi et al. (2012), Erdogan et al. (2010), Kahraman and Sunger (2011) and Kaplan, Flume (2010) showed that the students' motivational meta-cognition has been emphasized which is consistent with the findings of this study. According to the results of Gadampour et al. (1977), meta-cognitive training improves students' intrinsic motivation and their academic achievements.

Also, the findings of Sergolzaei et al. (2018) and Yu et al. (2006) indicate the impact of meta-cognitive education on students' focus. For example, Sergolzaei et al. (2018) has shown that meta-cognitive teaching practices affect emotional processing, impulsivity, and distraction in students with specific learning disorders. Meta-cognitive training focuses on the strategy of mindfulness learning, and in particular the positive strategy of cognitive re-evaluation of emotions, so reduces negative emotions, increases positive emotions and adaptive behavior, and demonstrates the student's ability to focus on academic tasks and lessons (Yu et al., 2006). So applying meta-cognitive training and emotion regulation techniques to students would increase their awareness of positive emotions, interest in adapting to the classroom environment, avoid distractions, and enhance their focus.

With meta-cognitive training, gifted students' self-test strategies increase their effort to review and prepare for classes and exams. Farrokhi (2010) showed that meta-cognitive strategies allow one to have more complete control over his / her performance due to the nature of the tasks. Therefore, these strategies, in order to facilitate successful experiences and provide the opportunity for practice, promote creativity and academic performance and a successful learning experience for gifted students.

The findings of Lavasani (2013), Alibakhshi and Zare (2011) and Weinstein and Hume (1998) also indicated the impact of meta-cognitive education on studying skills. For example, Weinstein and Hume (1998) showed that learners who use meta-cognitive skills are more successful and play a more active role in their academic destiny. Palman and Connolly (1984) emphasize the deficiency of studying strategies and the deficiency in its skills in students with test anxiety. According to this model, anxiety is not the main cause of these students' disruptions but poor study strategies and skills. The findings of Erdogan et al. (2010), Abedini and Mokhtari (2015), Narimani et

al. (2015) also showed the impact of meta-cognitive training on learners' time management.

Overall, training in meta-cognitive strategies empowers the context of scientific engagement, internal control source, positive attributes, motivation for further development, creativity and self-responsibility in individuals, and individuals' sense confidence in life; also helps people to identify problems and test their activities to act freely and independently and to provide the best solutions in various matters (Mahboubi & Mustafaei, 2006).

In general, according the present hypothesis, it can be concluded that, through meta-cognitive learning, students process information more quickly and apply their ideas in test strategies with a positive attitude in problem solving. Also they learn with motivation and enthusiasm. By using the focus component and especially the positive cognitive emotion evaluation strategies, the gifted students reduce negative emotions and increase positive emotions and adaptive behavior; they could process the questions they didn't know faster and develop well-studied tests and also they could apply time management strategies by learning cognitive knowledge. Therefore, meta-cognitive training improves teaching-learning strategies in gifted students. However the close proximity of the entrance exams and their fierce competition in scoring and their strong desire to lead did not diminish the anxiety of these gifted students, which made the component of the original idea meaningless.

Similarly, the strategy of meta-cognitive learning, learning, organizing and storing knowledge and its ease of use, planning, monitoring and control, time management, the method of trying, choosing studying environment and helping other people, anxiety control and avoiding procrastination or neglecting, highlighting the information and re-examining the training, combining these factors and practicing them improve students' academic performance. These strategies enable individuals to master their own learning and studying processes by fine-tuning their minds and type of studying. Also it seems that practicing these skills in long-run term would enhance academic performance. Students who use more meta-cognitive self-regulation strategies while trying to teach or study at the same time make sense of the information by making meaningful connections with prior information, controlling how this process works, and creating an appropriate learning environment to learn and improve their academic performance.

Some of the limitations of the study are as follows: given that the sample group consisted of high school boys in Ardabil, a gender-based research considering different ages of students is needed, so that the effectiveness of this strategy can be generalized to both sexes and all ages. Follow-up courses were not used in this study and training courses were limited to two months. It is recommended that future research on this subject be conducted on both sexes of different ages and as voluntary education groups so that this strategy can be applied to both sexes and all ages. Future research should use 3-6 month follow-up courses to evaluate the long-term effectiveness of these findings. If it is suggested to be used in gifted schools; meta-cognitive teaching methods should be coherent for teachers and students to develop their meta-cognitive skills. Also it is recommended to add a lesson called ’Meta-cognitive Education‘ in national curriculum.

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