

## The effect of synectics pattern on increasing the level of problem solving and critical thinking skills in students of Alborz province

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**Abstract:** The present investigation was aimed to study the effect of synectics pattern on increasing the level of problem solving and critical thinking skills in students of Alborz province in 2013. The method of the present investigation was of semi-experimental type with pre-test, post-test with control group and random assignment of subjects. The population consisted of 6725 of high school students in Alborz province in the academic year of 2013-2014. The statistical sample of the research consisted of 40 individuals who were chosen randomly. Afterwards, they were divided into two classes of 20 individuals, which one of the classes was a control group and the other was an experimental group. The data collection was based on questionnaire. The reliability of the questionnaires was based on Cronbach's alpha method. The calculated value was 0.84 for the standard problem-solving questionnaire of Heppner and Peterson (1982) and 0.94 for the standard critical thinking skills questionnaire of Facion (2007). In addition, the content validity was used in order to check the validity of the questionnaire. In this regard, the questionnaires were confirmed by the related specialists. The analysis of the obtained data from the implementation of the questionnaires was carried out by SPSS software in two parts of descriptive and inferential (covariance analysis). The findings demonstrated that the synectics pattern leads to increase in the level of critical thinking and its dimensions (inference factor level, analysis, deductive and inductive reasoning) at 95% significance level. It also leads to increase of problem-solving skills in students and its dimensions (trust on problem-solving, tendency-avoidance in problem-solving and personal control in problem solving).

**Key words:** *Synectics pattern; Problem-solving skills; Critical thinking; Reasoning; Personal control*

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### 1. Introduction

Problem solving and thinking skills are of proficiencies that should be thought in any educational systems. In this regard, the teacher should make effort to lead his student towards increasing in thinking and reasoning skills and make them think instead of parrot learning. Moreover, he should teach them how to find a proper solution, which is the basis of learning accompanied with thinking so that the student will be able to use the learned skill in variety of courses and even in different circumstances in his own life, because students' life were not limited to a specific issue, and learning thinking and problem-solving skills should be as the most important factors in the education. However, training of high-level thinking leads to facilitation of students' exposure to variety of challenges, which they probably have during their work life, occupational life and citizenship life. In addition, its consequences may be education of independent students that can confront with challenges reasonably (Ahmadi, 2011).

People use problem-solving skills in stressful situations and efficiency or inefficiency of these solutions plays an important role in their physical and psychological well-being. Having knowledge of

personality factors is very important in successful coping with life events, because personality factors have a close relationship with the issue that how does a person see the world and how he respond to the stressful factors and situations. From the cognitive perspective, solving a problem is a behavioral-cognitive and innovative procedure that one identifies or provides effective and compatible strategies for routine problems. This component has four activities that some of the authors named them "problem-solving stages". These activities are problem criterion and definition, creation of alternative solutions, decision-making, and performing and clarification of solution. Each of these purposeful and sophisticated activities plays a significant role in discovering and developing an adaptive coping response against specific problematic situations (Amir Hosseini and Mokhtab, 2008).

On the other hand, problem solving is an important coping strategy that increases personal capability and progress and decreases stress and psychological semiology. All people continuously face with variety of issues and problems and decision making about their quality. Various problems and issues have been increased due to complicated importance and changes in current societies. The process of routine problem solving is done automatically most of the time in a way that

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individuals cannot realize its method of accurate implementation. Nevertheless, it should be noted that people's everyday life would be broken down without identification of problems and finding implementable solutions. Problem solving includes cognitive-emotional and behavioral scopes. Individuals who have the capabilities of solving problems can deal with life problems and stress better. Based on this, problem solving consisted of personal control, one's belief to control personal behavior and emotions in confronting with problems, trust on problem-solving, belief in one's capability for solving problems, and the avoidance-tendency criterion that shows positive attitude towards problems and tendency to face with issues (Mohammadi, 2008).

Critical thinking is of other superior cognitive skills that plays an important role in human's different life aspects. This concept came from a Greek word "critic" means questioning, giving meaning and analyzing. Based on the definition raised by the national council for the development of critical thinking (1996), it is a systematic and purposeful process in which one actively deals with the conceptualization, application, analysis, combination and evaluation of collected or produced data and walks towards belief and action through observation, analysis and reasoning (Sene, 2004).

Ennis (1991) believed that critical thinking is reasonable, logical and focused on decision making on action and beliefs. Moreover, it includes many activities such as development of hypothesis, observation using different methods, analysis, looking for evidences and being valuable. He stated in his definition that, there is difference between skills (analysis of arguments, to judge the credibility of sources, identification the main point of the problem and challenging the problem) and tendencies and preparedness (being prepared to keep focused on the results or question, being prepared for searching and presenting reasons, determination to explore different options and suspension of judgment in the case of lack of evidence and enough reasons) (Badri and Fathi, 2007).

Critical thinking consisted of six skills including interpretive skills (including classification, decoding sentences, clarification of meaning, investigation of ideas and analysis of ideas), inferential skills (including searching for evidences, speculation about alternatives and extraction of results), evaluation skills (including evaluation of claims, evaluation of discussions, expression of results, justification of procedures and presentation of reasoning), deductive reasoning skills (including logical reasoning in mathematics) and inductive reasoning skills (including conclusion from the discussion following the confrontation with facts related to presumptions) (Andonli, 2004, quoted by Mehri Nezhad, 2007).

According to Halpern (1996), critical thinking is a purposeful and reasonable thinking. It is a kind of thinking that is involved in problem solving,

interpretation, calculation of probabilities and decision-making. Although Halpern uses the term "critical thinking", most of the theoreticians prefer to use "thinking skills" instead of "critical thinking".

Seifert (1998, quoted by Seif, 2011) stated about this mental activity and its differences with problem solving that critical thinking often but not always deals with open problems and issues but problem-solving often deals with problems and issues which have specific and unique responses. In addition, critical thinking has elements of the evaluation, while evaluation has no role in problem solving.

On the other hand, synectics pattern is an active pattern in the process of learning-teaching. The synectics method designed by William Gordon and his co-workers for innovation and promotion of design creativity. Gordon started training creativity groups in industry and made it in a way that it can be applicable for students. According to him, creativity with synectics consisted of four ideas that ask for encountering with traditional approaches about creativity. Previous approaches about creativity stated that creativity is inherent and it cannot be taught. Gordon declined the previous approaches and stated that creativity can be seen in daily activities and daily activity can be creative (Hosseini and Memarian, 2009).

In this pattern, which is of information processing family, activities are tracked through variety of comparisons and the similarity-making principle is used for receiving new concepts and their application. Moreover, one in any situation can help to new idea generation and understanding the way of relationship between the concepts. Since the pattern motivates students' mind towards thinking in the context of different dimensions of the subject, it increases the mental capabilities such as increase in the level of learning and recalling in students (Shabani, 2011). Bani Aghil (2009) stated in an investigation that synectics increases the educational attainment scores in comparison with traditional approaches and increases the level of recalling and reminding the students' knowledge.

As an education method, synectics are usually used for the creation of new approaches about a subject or an issue. This method is used to clarify or develop new concepts or alternative solutions caused by opening contents (Dastjerdi, 2001). In this method, an opportunity of creation of new and creative solutions using previous knowledge is given to a person. Synectics is also named defamiliarization. It means an individual tries in this method to look at familiar things and issues in a fresh view. In fact, it is a method to help the learners to change the current order on their minds in activities accompanied with problem solving and create new methods in problem-solving (Ouji Nezhad, 2003).

The most important principle in synectics method is using comparisons. Synectics gives creativity to the individuals to look at phenomena in a different point of view and solve their problems in a different way. Based on this, this method is named

metaphorical thinking or intellectual innovation (Shabani, 2011).

The synectics method brings a construction using metaphorical activities that students can improve their imagination and sight using it. Using comparisons is the major component in synectics or metaphorical thinking. Students work with variety of comparisons in order to make more metaphorical comparisons using the obtained tranquility. Then, they use the made comparisons in order to solve problems or present a new idea. In fact, the main objective of synectics or creativity is breaking the conventional rules and creating new solutions to problem (Joyce et al., 2013).

The synectics learning pattern leads the learner to an illogical world or a world far from logic. An opportunity is provided there in order to make the learners realize new ways of understanding things, problems, concepts and occurrences. Metaphors and synectics help teachers to find and apply new ways of thinking about students, their motivations, nature of punishment and nature of the problems (Shabani, 2011).

Gordon defined synectics or metaphorical thinking based on four ideas or thought.

First: creativity has importance in daily affairs and it is not only for art and improvisation. Creativity is a part of our life at work and leisure time.

Second: the process of creativity is not so mysterious. Moreover, it is not limited to certain people and individuals who are familiar with the foundations of creativity can find their ways to creativity.

Third: creative innovation is similar in all fields of experimental sciences, mathematics and humanities.

Fourth: creative thinking or individual and group innovation are very similar to each other. Individuals and groups create their ideas and production in a similar manner (Joyce et al., 2012).

Many researches have been conducted on the role of synectics patterns in critical thinking, problem solving skills and its impact on creativity, learning, etc., and some of the conducted researches in this field are mentioned in the following:

Julie et al. (2014) found in an investigation entitled "exploring the relationships between teaching, approaches to learning and critical thinking in a problem-based learning foundation nursing course" that the aspects of problem-focused learning approach have impact on adaptive learning approaches of students and their preparation of critical thinking skill.

Beghetto (2013) demonstrated in an investigation on creativity and ways to improve it that discussion in classrooms in the context of class activities leads to increase in creative activities.

Ahmadi et al. (2013) found in a research entitled "study of the impact of synectics pattern on knowledge, skill and attitude of first grade high school students in social education lesson" that educational attainment in social skills lesson of the experimental group, which were taught using

synectics method, was more than the control group, which were taught using traditional method, and the difference was significant. Moreover, the study of the impacts of synectics teaching method on knowledge, skills and attitudes of students demonstrated that teaching life skills using synectics method has positive impact on the attitudes, skills and knowledge of students.

Zarei Zavarki et al. (2012) stated in their research on the impact of synectics patterns on creativity that the synectics teaching method has more impact on the fostering of creative thinking and promotion of learning and teaching in the students than traditional methods do.

Darzi Ramandi (2012) indicated in a study on the impact of synectics teaching method on increasing creativity and educational attainment in social education lesson of second year middle school students of Boin Zahra city in 2011-2012 educational year that synectics teaching pattern leads to enhancement of educational attainment of students.

Mahmoudi (2012) demonstrated in his research conducted on elementary school students that synectics teaching method leads to creativity in the students.

Abd Al-Maleki (2011) found in his investigation entitled "studying the impact of synectics teaching method on creativity and educational attainment of the life skills lesson in junior high school students in Sanandaj city" that the synectics pattern leads to improvement in the performance of students in both creativity and educational attainment.

Ahmadi (2011) concluded in his research that teaching based on synectics teaching method leads to increasing creativity in answers, ideas and activities of students. On other words, using the teaching method provides the groundwork for creative ideas.

Ghamari (2011) also demonstrated in study on the impact using synectics teaching pattern (Direct Comparison) in educational attainment of third year high school students in "direct-current electrical machines" lesson that this pattern leads to improvement of students' performance in the process of learning and recalling.

Angeli and Valdis (2008) found in an investigation about the effect of developing methods for teaching critical thinking skills, which four 72-individual groups from students were used as the participants and four different teaching methods were employed, that students who were in the synectics teaching group had higher level of critical thinking than the traditional method of training.

Curtis (2008) demonstrated in a research entitled "exploring relationships between critical students' solutions to problems in Mendelian genetics" that there is a significant relationship between cognitive factors with critical thinking and problem solving styles.

Deniel (2006) studied participation attitude of students in the learning and development of critical thinking and the role of other teaching methods. He found that when educational freedom is guaranteed

in the classroom for students and students have chance for thinking, it has effect on the improvement of their critical thinking skills. Moreover, the role of teachers and trainers in the creation of an atmosphere in which students are able to state their comments and insights easily is significant, and attendance in such classes enhances the critical thinking skills in students considerably.

Moreover, Tajri (2006) found in his research entitled "studying and comparing synectics teaching methods and lecture method in fostering creativity and educational attainment in social education lesson" that there are significant differences between students who learn social education lessons with synectics method and those who learn it using lecture method.

Anderson, How and Sodden (2004) also studied the impact of learning critical thinking skills on more education of students. The program in which critical thinking skills were taught was designed and 84 students participated in it over 10 sessions. He found that dialog has impact on critical thinking and written work, whether of weak types in the use of stories and generalization or strong types such as researching can be effective in increasing the level of critical thinking.

Since it is necessary to foster creative and thinker human resources for complex social living in today's modern world in which all communication devices and different education methods are provided, it is important to choose the most appropriate way in achieving it. Based on this and according to the fact that synectics teaching method is of new teaching methods which leads to development of thinking and problem-solving capacity of students, creative expression and development of new ideas, it is necessary to evaluate the impact of this method on different components such as critical thinking, problem-solving, educational attainment, creativity, etc. (Amir Hosseini, 2011), because development of such skills leads to independency and progress of individuals in different aspects of life, so dynamism and growth could be expected in the society. Therefore, according to the role of problem-solving

skill and critical thinking in the daily life and also educational attainment, and the impact of synectics pattern on cognitive skills such as creativity and innovating, the present investigation is aimed to answer to the following question. Does the synectics teaching pattern have impact on the level of problem-solving skill and critical thinking in the high school students? In this regard and according to the theoretical foundations and literature review, the research hypotheses are designed and developed as follows.

*The main hypothesis 1:* the synectics pattern leads to increase in the level of critical thinking in students.

*The sub-hypothesis 1-1:* the synectics pattern leads to increase in the level of analysis and interpretation factor in critical thinking.

*The sub-hypothesis 1-2:* the synectics pattern leads to increase in the level of evaluation and analysis of inferences factor in critical thinking.

*The sub-hypothesis 1-3:* the synectics pattern leads to increase in the level of extraction of logical inferences factor in critical thinking.

*The sub-hypothesis 1-4:* the synectics pattern leads to increase in the level of inductive reasoning factor in critical thinking.

*The sub-hypothesis 1-5:* the synectics pattern leads to increase in the level of deductive reasoning factor in critical thinking.

*The main hypothesis 2:* the synectics pattern leads to increase in the level of problem-solving skill in students.

*The sub-hypothesis 2-1:* the synectics pattern leads to increase in the level of confidence factor in problem solving.

*The sub-hypothesis 2-2:* the synectics pattern leads to increase in the level of avoidance-tendency factor in problem solving.

*The sub-hypothesis 2-3:* the synectics pattern leads to increase in the level of personal control factor in problem solving.

The conceptual model of the research is also shown in Fig. 1.

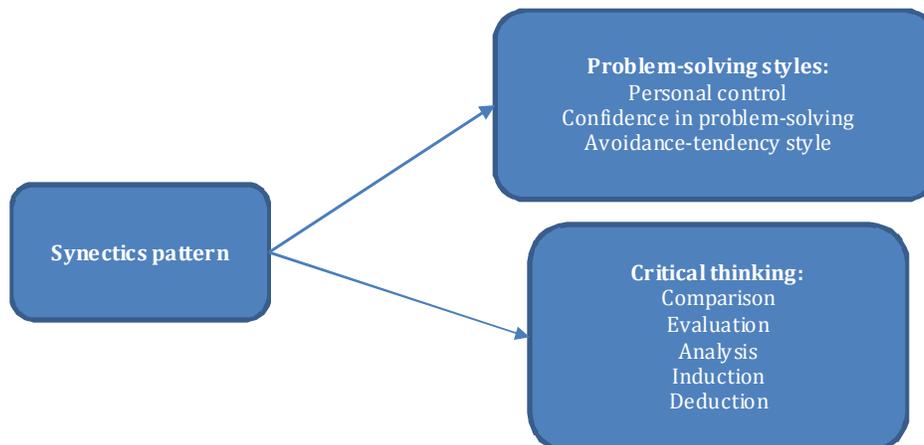


Fig. 1: Conceptual model of the research

**2. Methodology**

Since the present investigation was aimed to study the effect of synectics pattern on critical thinking and problem-solving styles in students, the method was of semi-experimental type with pre-test, post-test with control group and random assignment of subjects. As a independent variable, synectics pattern was taught within five sessions in biology classroom and critical thinking and styles of problem-solving was studied as dependent variables in pre-test and post-test. Moreover, the variables of age (participant was 16 years old), sex (participants were female), field of study (experimental science) and teacher (it was the same for both experimental and control group) were controlled by the researcher. In addition, the effect of pre-test on post-test was also controlled using covariance analysis test.

The population consisted of 6725 of high school students in Alborz province in the academic year of 2013-2014. The statistical sample of the research consisted of 40 individuals who were chosen randomly. Afterwards, they were divided into two classes of 20 individuals, which one of the classes was a control group and the other was an experimental group.

In order to assess the problem-solving style, the standard problem-solving questionnaire of Heppner and Peterson (1982) with 32 questions was used, which was designed based on six-point Likert scale and evaluated the dimensions of personal control (5 questions), confidence in problem-solving (11

questions) and avoidance-tendency style (16 questions). On the other hand, the standard critical thinking skills questionnaire of Facion and Facion (2007) with 34 questions, which was designed with four and five-points scale (20 questions had four choices and 14 questions had 5 choices), was used in order to evaluate the dimensions of comparison, evaluation, deduction, induction and analysis. In this regard, the Cronbach's alpha coefficient was used in order to check the reliability of the questionnaires, which it was 0.84 for standard problem-solving questionnaire of Heppner and Peterson (1982) and 0.94 for the standard critical thinking skills questionnaire of Facion and Facion (2007). Moreover, the content validity was used in order to check the validity of the questionnaire, which the questionnaires were confirmed by the related specialists.

The data analysis obtained from the implementation of the questionnaires was carried out in two parts of descriptive and inferential (covariance analysis) through SPSS software.

**3. Findings**

In this section, average and standard deviation of the research variables were firstly entered to the pre-test and post-test and then, covariance analysis test were utilized in order to check the research hypotheses, which the results are mentioned in Table 1 to Table 3.

**Table 1:** Average and standard deviation of critical thinking divided into groups in pre-test and post-test

Post-test				Pre-test				Scale levels
Exp. Group N = 20		Control Group N = 20		Exp. Group N = 20		Control Group N = 20		
M	SD	M	SD	M	SD	M	SD	
1.59	10.82	1.65	16.89	1.79	9.58	1.84	9.52	Critical thinking Evaluation Deduction Analysis Inductive reasoning Deductive reasoning
1.61	3.59	1.68	5.48	1.62	3.44	1.53	3.23	
1.45	3.36	1.74	6.56	1.36	3.08	1.51	3.10	
1.58	3.16	1.57	4.91	1.46	3.04	1.77	3.17	
1.45	4.41	1.78	8.73	1.45	4.20	1.43	4.06	
1.68	3.23	1.59	6.69	1.68	3.13	1.52	3.09	

Average and standard deviation of critical thinking and subscales in two groups of experimental and control are demonstrated in Table 1. The average pre-test score for critical thinking in the experimental group was 9.52 and it was 9.58 in the control group. It seems that the two groups are

the same in terms of functional ability of critical thinking while the scores were 16.89 and 10.82 in the post-test. Therefore, the level of scores of experimental group (both in total score and subscales) were increased.

**Table 2:** Average and standard deviation of problem-solving skill divided into groups in pre-test and post-test

Post-test				Pre-test				Scale levels
Exp. Group N = 20		Control Group N = 20		Exp. Group N = 20		Control Group N = 20		
M	SD	M	SD	M	SD	M	SD	
17.53	112.82	16.42	67.71	18.59	118.59	17.18	116.9	Problem-solving
5.42	39.92	4.02	23.40	5.62	40.78	5.06	39.34	Trust on solving problems
7.01	56.59	6.37	34.85	7.11	58.05	7.46	59.58	Tendency-avoidance
4.07	16.31	2.45	9.47	4.09	18.89	3.47	17.15	Personal control

Average and standard deviation of problem-solving skills and its subscales in two groups of experimental and control are demonstrated in Table 2. The average pre-test score for problem-solving in the experimental group was 116.19 and it was 118.59 in the control group. It seems that the two

groups were the same in terms of functional skills while the scores were 67.71 and 112.82 in the post-test. Therefore, it seems that the experimental group had higher scores compared to the control group after employment of synectics teaching method.

**Table 3:** The results obtained from the covariance analysis test on the mean scores of critical thinking and problem-solving skill

Test power	P significance level	F	DOF	Mean square	Variables
0.68	0.006	3.25	1	316.61	Critical thinking Evaluation Deduction Analysis Deductive reasoning Inductive reasoning Problem-solving Confidence in problem-solving Avoidance-Tendency Personal control
0.61	0.024	1.08	1	125.45	
0.65	0.021	1.54	1	144.09	
0.51	0.42	0.86	1	68.92	
0.65	0.031	2.82	1	210.67	
0.58	0.16	1.52	1	144.05	
0.78	0.0001	17.48	1	8689.98	
0.72	0.001	9.27	1	3343.21	
0.75	0.001	14.61	1	4648.92	
0.70	0.001	7.38	1	2070.28	

As it was demonstrated in Table 1, the obtained data was assessed using covariance analysis test and the results are mentioned in the following.

The first main hypothesis and its subordinate hypotheses: synectics pattern leads to increase in the level of critical thinking and its dimensions (evaluation, deduction, analysis, deductive reasoning and inductive reasoning) in students.

According to the results listed in Table 1, since the values of F for critical thinking and its dimensions (evaluation, deduction, analysis, deductive reasoning and inductive reasoning) are bigger than the significance level, these hypotheses are approved. Therefore, it can be concluded in all of the hypotheses at 0.95 confidence level that the implementation of synectics pattern leads to improvement of critical thinking skill and its dimensions in students.

The second main hypothesis and its subordinate hypotheses: synectics pattern leads to increase in the level of problem-solving skill and its dimensions (confidence in problem-solving, avoidance-tendency and personal control) in students.

According to the results listed in Table 1, since the values of F for problem-solving skill and its dimensions (confidence in problem-solving, avoidance-tendency and personal control) are bigger than the significance level, these hypotheses are approved. Therefore, it can be concluded in all of the hypotheses at 0.95 confidence level that the implementation of synectics pattern leads to improvement of problem-solving skill and its dimensions in students.

#### 4. Conclusion

Using metaphor activity, synectics method provides a format in which students can settle themselves in a situation that leads to improvement of their insight and imagination. Using comparison in

the most important component in synectics or metaphor thinking. Students work with variety of comparisons in order to conduct more metaphor comparisons. Afterwards, they use the comparisons in order to solve problems or present new thoughts and ideas. In fact, the fundamental objective of innovation or synectics is breaking conventional and common concepts and rules and creation of new methods and ways to solve problems (Behrang, 2009). The main purpose of the present research was to study the impact of synectics pattern on increasing the level of problem-solving skill and critical thinking of students in Alborz province.

In this section, the research hypotheses were assessed using obtained information and data and their analysis.

- The first main hypothesis and its subordinate hypotheses: synectics pattern leads to increase in the level of critical thinking and its dimensions (evaluation, deduction, analysis, deductive reasoning and inductive reasoning) in students.

As it was stated in the findings section, synectics pattern leads to increase in the level of critical thinking and its dimensions (evaluation, deduction, analysis, deductive reasoning and inductive reasoning) in students. The results in the context of covariance analysis in the two groups indicate that the experimental group got higher scores in comparison with the control group and the difference is significant statistically. In fact, it demonstrates that students taught using synectics teaching method have higher level of critical thinking. The finding is in line with the results of other researchers including Julie et al. (2014), Ahmadi et al. (2013), Zarei Zavaraki et al. (2012), Mahmoudi (2012), Darzi Ramandi (2012), Abd Al-Maleki (2011), Ghamari (2011), Angeli and Valdis (2008), Tajri (2006), and Anderson et al. (2004).

It can be stated in explaining the findings that since using comparisons is the most important

concept in synectics method; it gives opportunities for thinking, imagination and initiative to individuals in order to look at phenomena from a new perspective. On the other hand, they will be able to solve their own problems and issues and provide new mental constructs using metaphorical activities. According to Shabani (2011), the main and fundamental objective of innovating or synectics method is breaking the conventional rules and creating new solutions to the problems. Moreover, they are aimed to help individuals to break the previous mental background and find a proper way to think in a new way.

On the other hand, critical thinking is a self-made and purposeful judgment that leads to interpretation or analysis, evaluation and deduction. Moreover, it is relied on proof and evidence, conceptual, regular and regulated explanation and it is based on judgment considerations. Therefore, synectics method leads to the development of mental fields in student through creation of free and safe environment, attraction of students' participation and repeatedly encountering with contradictory analogies, and challenges them to different aspect of a subject or phenomenon. This pattern asks the students to think about other's reasoning and also make them to reason out against them.

The notable subject here is that according to Griffin and Everett (2002), the critical thinking skill is not in a way in which dramatic increases happen through the entrance of a briefed lesson into the educational content. On the other hand, they believe that critical thinking is formed and can be perfect in a long period and based on proper social interactions, purposeful educational system and potential familial and mental backgrounds.

According to Deniel (2006) in an investigation that has been conducted to study the participation attitude of students in education and development of critical thinking, when educational freedom is guaranteed in a class for the students and students have opportunity to think and they can listen to the words of others with an open mind, it has a significant effect on the progress of their critical thinking. The role of teachers in the creation of an environment in which students can present their ideas and points of views freely is very important and fundamental, and attendance in such a designed and programmed class can enhance the critical thinking of students remarkably.

These findings are in harmony with the conducted researches of Zarei Zavarki et al. (2012), Abd Al-Maleki (2011), Tajri (2006), Anjeli and Valdis (2008), Deniel (2006) and Anderson et al. (2004).

- The second main hypothesis and its subordinate hypotheses: synectics pattern leads to increase in the level of problem-solving skill and its dimensions (confidence in problem-solving, avoidance-tendency and personal control) in students.

As it was stated in the findings section, synectics pattern leads to increase in the level of problem-solving skill and its dimensions (**confidence in**

**problem-solving, avoidance-tendency and personal control**) in students.

It can be stated in explaining the findings that the most important concept in synectics method is using comparisons. The results obtained from covariance analysis in the context of synectics teaching pattern in the two groups indicate that the control group got higher scores in comparison with the experimental group and the difference is significant statistically. In fact, it shows that students taught using synectics method are more skilled in problem-solving. The findings are in line with other researches such as Julie et al. (2014), Ahmadi et al. (2013), Beghetto (2013), Mahmoudi (2012), Ahmadi (2011), Abd Al-Maleki (2011), Curtis (2011), Tajri (2006) and Deniel (2006). Synectics gives creativity to the individuals to look at phenomena in a different point of view and solve their problems in a different way. Based on this, this method is named metaphorical thinking or intellectual innovation (Shabani, 2011), while the present learning pattern leads the learner to an irrational or far from logic world. There is an opportunity for the learners to find innovative ways of understanding things, issues, concepts and events.

Problem solving is shaping a variety of responses and choosing an appropriate answer from multiple responses. Scientists defined problem solving as a targeted measure to achieve a particular goal. In this regard, Wong and Chi Wong (2006) defined deductive method, the hill climbing method, algorithm approach (repeated steps), comprehensive search, division and analysis as common methods in problem solving.

As it was demonstrated, all the methods in the field of problem solving are somehow existed in synectics method too, and it is frequently used by the learners in each educational sessions. Synectics is in fact the method of comparisons. Students discuss and debate together about a subject as a progressive system and in any case, they have to use their imagination and initiative. As it was shown in different researches such as Ahmadi (2011), Abd Al-Maleki (2011) and Mahmoudi (2012), synectics increases the level of creativity in the learners.

On the other hand, all the students can participate actively in class discussion and it sometimes has impact on the discussion process and has positive orientation. Students talk freely about their feelings in public and even acquire the skill of listening to opinions and feelings of others, each of them can be a factor to provide sense of self-confidence, self-esteem, self-efficacy, assertiveness and self-control for the learners. Based on this, the difference between the scores of two scales of personal control and confidence on problem solving in control group and experimental group is justifiable.

According to the total results, it can be stated that education and training is not only providing information and knowledge but also full development of human personality and individual abilities. Using such a perspective, teachers are surely located at the center of the educational

process and education is impossible without them. They should find methods in order to make today's children and teenagers ready to live in the future unpredictable world. Many articles have been written about the purpose of education and training, and most of the specialists in the field of education and training believe that education should provide the level of growth to the students that they could not reach to that level lonely. Learning how to know, how to behave, how to live with others and how to be is some of those educations. In the meantime, new methods of teaching such as synectics can have positive effects such as increasing the level of self-confidence, self-esteem, creative thinking and fostering empathy, and ability of solving conflicts and overcoming emotions through changes in the styles of teachers' interaction with learners, creating diversity and vitality in the classroom and creating social communication in the classroom.

Undoubtedly, today's civilized society demands citizens who learned to properly deal with others and their opinions and respect them, and respectfully criticize their opinions at the same time and do not assume a theory absolutely right and prevent despotism positivist thinking development (Hashemi, 2006).

At the end, it is appropriate to finish the discussion using a statement from Whitehead: learning of the students is useless unless they lose their books, burn their pamphlets and forget the memorized details of their exam.

Since the results of the research indicate the impact on synectics pattern on improving problem-solving skills and critical thinking in student, the following suggestions are proposed.

- It is proposed that teachers make themselves familiar with new methods of teaching and they should be empowered in using the methods properly. Moreover, the concept of basic cognitive abilities of mind such as critical thinking and its role in personal and social life of students and also ways to improve and develop them for teachers should be presented.
- To design educational objectives and appropriate methods to develop children's mental performances (such as critical thinking, problem-solving, creativity and memory) together with subjects related to content of the lessons.
- To provide educational books and concepts in order to attract participation and cooperation of the students during the teaching process.
- Teachers should utilize problem-solving and project-focused teaching methods, because employment of such methods in education could determine, discover or invent new, adaptive and effective strategies for confronting daily problems of students.
- Formative or final assessment of class should assess and evaluate claims and discussions and students state the results of what they learned. Moreover, they should be able to justify the procedures.

- To hold emotional intelligence workshops, so the students would learn that they should control their emotions in case of confronting problems.

Any investigation is facing special limitations, so the present research was not an exception. The following limitations can be mentioned in this regard.

1. It was limited to 2013 in terms of time and second year of high school in Alborz province based on location.
2. The only measurement tool was questionnaire and other tools such as interview, observation, etc. were not used. Therefore, limitations subjected to the questionnaire should be mentioned in the results.

In addition, there were limitations out of researchers' control as follows.

1. Since the method was different from students' framework of the class, some difficulties and problems emerged in the primary sessions.
2. School administrations' satisfaction in providing a class for the research was the other difficulty in the meantime.

According to the value-adding and score-focused atmosphere of the educational system, better performance of the experimental group in problem-solving and critical thinking questionnaires might be as a result of lower levels of anxiety and stress came from pattern implementation process.

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