CHAPTER -7
DISCUSSION OF THE RESULTS

This chapter is devoted to discuss the main results as outcome of the study. The results have been discussed to get the further insight into the matter. As the major objective of the study was the effect of creativity training program, the same is discussed in the preceding paragraphs.

7.1.0 Effect of Creativity Training Program on Concept Map Performance

The study has revealed that creativity training program has significant effect on the concept map performance qualitatively as well as quantitatively. The major finding of the study is that there was a significant difference in the post test scores of concept map performance test between control group and experimental group. It has clearly indicated that the students of experimental group achieved much higher scores after the exposure to the creativity training program than the control group. Moreover, the students of experimental group have shown an improvement in the concept map structure in comparison to the control group students after exposure to creativity training program. These results can be explained from process of concept mapping, various theories of concept mapping i.e. knowledge representation theory, subsumption theory, constructivist learning theory, and meaningful learning theory, process of creativity training program, strategies of creativity training program and principles of creativity training program.

7.1.1 Theories of Concept Mapping

Studies on the use of concept maps have indicated positive effects in various aspects of its utility (Mok et al., 2006; Romance & Vitale, 2002; Shavelson et al., 2005). The current study can be well explained by various theories of concept mapping. These are as under:

(a) Knowledge Representation Theory

The explanation of the findings of present study lies in knowledge representation theory. In knowledge representation theory, knowledge is organized somewhat structurally (Lin, 2002). Learners draw conclusions from the concept map’s hierarchy and graphics
(Novak & Gowin, 1984). When a teacher introduces a proposition (concept), a knowledge set is also introduced. Faced with such a proposition, students begin to make associations and then to select, organize, and categorize these associations, connecting ideas and drawing graphs to represent their own understanding. This may be the reason that when content analysis of the students’ concept maps was done, it clearly indicated that creativity training has affected the way students selected the relation between various concepts in their concept maps. It helped them to categorize various concepts’ association with each other. It revealed that students have gained understanding of links and various meanings for single concepts. The structures prepared by the learners were almost ‘spoke’ type before creativity training program but afterward the structure improved and was ‘network’ type. This means that propositions were selected, organized in a more meaningful way and old ideas were withdrawn and connected in a new way to reveal a better knowledge representation.

Another explanation can be seen in that concept maps are visual, directional, hierarchical, and sequential and are created through knowledge convergences. Through this graphical and visual representation, students could easily see the concepts that will result in knowledge migration, followed by reorganizing and reconstructing of knowledge structure. When the first maps prepared by the students were analyzed, there was no organization of concepts technically as well as understanding wise. But while creating the first concept map, the students gained visual understanding. It helped them to create second concept map in better way for knowledge migration and reconstructing the same idea. Concept maps allow learners to organize their prior concepts and experiences and build new knowledge on previous concepts.

The benefits of concept map reported in the literature include organizing information, assisting learning, communicating particularly complex concept maps, understanding literature, improving clarity, testing students’ learning progresses, and more (Novak & Gowin, 1984; Novak, Gowin, & Johansen, 1983; Ruddell & Boyle, 1984) are in line with the existing study. For these reasons, it is argued that concept maps stimulated knowledge transfer from one situation to another and thus helped learners in knowledge representation.
(b) Subsumption Theory

Another explanation for the effectiveness of creativity training program on concept map performance test can be seen in subsumption theory. According to Ausubel's (1963) theory of subsumption, individuals recognize, connect and incorporate new information into higher-level concept groups. That is to say, learners put new concepts into a larger, more comprehensive category and then reorganize or gradeify the new and old information. This can be achieved only if the new knowledge is relevant to the previous one. In other words, human brains are designed to seek meaning. In order for authentic learning to take place, information must be processed in a way that makes sense to the learner (Jensen, 2000). This procedure will only happen when the information has relevance to the learner. Relevance is a personal perspective; each learner has to make his/her own personal connections in order for the brain to find meaning in new experiences. In the course of relevant learning, new information is linked with concepts in cognitive structure. Usually this linkage occurs when more specific, less inclusive concepts are included to more general existing concepts in cognitive structure. In simple way it can be seen that these subsumers play a significant role in acquisition of new information. The role of this subsuming concept is an interactive one, facilitating movement of relevant information through the perceptual barriers and providing a base for linkage between newly perceived information and previously acquired information. Furthermore, in the course of this linkage, the subsuming concept becomes slightly modified and the information is also altered somewhat. This subsumption process changes in small ways. This is why the students remain active throughout the process because new concepts when added into the previous one brought them a relevance to a specific concept used. And therefore, they were able to relate the new information with the previous knowledge in a relevant manner.

(c) Constructivist learning Theory

Still another explanation of the present study can be seen in constructivist learning theory. This theory argues that knowledge is constructive. In construction of new knowledge, learners generate knowledge and meaning from their past experiences. At first, learners assign simple meanings to objects and phenomena. Knowledge becomes
more complicated as learners become more experienced (Jonassen, 2000a). Essentially, constructivism says that (1) learners are the center of learning, and knowledge is constructed based on their past experiences; (2) new knowledge is constructed based on experience or old knowledge; (3) learning incorporates and gives meaning to the old and the new; and (4) knowledge is complicated and contextual, and learners must exhibit their understanding in complex situations (Jonassen, 2000b). Constructivism is about building new ideas on old knowledge with creativity and thinking being emphasized. Learners can, therefore, flexibly construct their own mental modes and cognition.

In the same way, from the perspective of constructivist learning theory, concept map is not only a self-driven learning style, but a self-directed learning experience (Teo & Gay, 2006). In other words, it makes room for learners to figure out what is suitable for them. Self-directed learning helps individuals progress in learning through multiple stages: knowledge, comprehension, application, analysis, synthesis, and evaluation out of which last three are included in higher order thinking skills. Furthermore, when for the first time students prepared concept map, they have not prepared good maps but they gained the insight while preparing maps for their misconceptions about the ‘concepts’ and therefore, they used their experience in the second map. It is likely that during concept mapping instructions as well as creativity training instructions, the students learnt about the relationship between different ideas in the ‘concepts’. When understanding the relationship, students gained deep understanding about the concepts and this led to their achievement in concept map performance test. But students in control group did not understand the material deeply perhaps because they studied them in the traditional way.

The findings of the present study are in line with the study of Akinsanya & Williams, 2004, when they say that the construction of concept maps helps pull together information already known about a subject while integrating new information as we learn and expand our understanding.

(d) Meaningful learning Theory

Another plausible reason for the results can be seen into meaningful learning theory. Under the meaningful learning theory, new knowledge is deliberately combined with the old cognitive structure. Scholars (Ausubel, Novak & Hanesian, 1978; Novak,
Gowin & Johansen, 1983) argue that to see fruitful learning results, concepts must be endowed with meaning. They claim that meaningful learning builds upon an original cognitive structure that has already been comprehended. Novak (1998) proposed three prerequisites for meaningful learning: (1) learner’s prior knowledge; (2) teacher’s meaningful material; (3) learner’s choice. In other words, teachers should prepare meaningful material according to the individual’s prior knowledge. This enables the students to make sense of their learning by building on old knowledge and their own cognitive structures. The present creativity training program had all the three aspects. Lesson plans were so developed as to bridge the gap between the prior knowledge as well as the new coming knowledge. The technique of concept mapping also considered the prior knowledge of the students. The students were able to choose the concept of their own choice as per their previous knowledge from the list of concepts provided. Therefore, a significant difference was found before and after scores in concept map performance test. Moreover, concept mapping can help students learn to organize and symbolize knowledge by drawing. This facilitated students’ attainment of the goals of meaningful learning and increasingly effective knowledge, which expands thinking ability, stimulates creativity and arouses inspiration.

Numerous studies indicated that concept mapping is an effective learning strategy that precipitates meaningful learning for different learners in a variety of fields, such as science (Kinchin, 2001). The students saw concept maps as a way to organize the knowledge that they bring in a personal way. They looked forward to organize their thoughts in a way that makes sense to them. Meaningful learning involves having that framework of prior knowledge arranged in a way to be able to access it, and being able to place new knowledge within that framework so that it makes logical connections (Bransford et al., 2000).

7.1.2 Process of Concept Mapping

The explanation for the results of present study can be seen in the process of concept mapping. In concept mapping, each proposition is composed of two ‘concept’ nodes, which are connected by relation links. Concepts are connected in a hierarchical structure in which general concepts are placed higher and specific concepts are placed
lower (Novak, 1976; Novak & Gowin, 1984). In the process, learners must repeatedly ponder the topic structure to combine the abstract and scattered pieces of knowledge into something meaningful (Novak & Gowin, 1984; Novak & Musonda, 1991). In other words, concept maps characterize and symbolize a knowledge concept and aid creativity and diversity in the process of embodiment (Tseng, 2001; Hammond & Allinson, 1989; Mintzes, Wandersee & Novak, 2001; Novak, 1977; Novak & Gowin, 1984).

Another aspect of concept mapping process is that creating concept maps requires activity from both hemispheres of the brain. This whole-brain thinking is needed when making decisions about keywords, symbols and images. Together with divergent thinking, everything one learns can be presented through visual and graphical note taking. This can be further explained through the findings of Chen, 2004 who concluded that this handy tool can be used by students to integrate ideas, brainstorm, free associate, inspire and memorize. Further, it can be explained through the findings of Wang and Hsu when they concluded that concept mapping in education inspires creativity, enhances visual performance and helps students to think independently. Students eventually realize there is no correct answer in the world of creativity, and with the help of concept maps they can review and analyze their work. This process enables metacognition and enhances analytical ability. When students have a clear understanding of the structure of a concept map they can access concepts, topics and relevant resources that help them perform better in designing concept maps.

The above written paragraphs speak out that concept mapping process helped secondary school students because the process uses visual graphics to organize, induce and incorporate new ideas. This helped students to see their own progress by connecting related concepts. Therefore, concept mapping process not only stimulated creativity but also improved creative performance. Concept mapping process helped students not only in understanding the relationships among concepts, but also communicated this understanding to their grade mates. Through discussion, individuals could understand better what they had learned and modified it to be more clear and comprehensive. In this way, the concept mapping process benefitted all participants.

Another plausible reason can be seen in that previous studies has also emphasized the relationships among important concepts and concluded that relationship helped
students to generate creative thoughts, to make conceptual connections while doing team tasks. Moreover, at the communication stage, students share knowledge and clarify misconception when they collaboratively plan and discuss the construction of concept maps. That is why, during the creation of second map, one student indicated that he was able to determine the key points of lesson and concept map as he decided where to place each idea he was including. The process of giving thought to his content and deciding how to effectively place it all on his map moved this student from confusion in his first experience to satisfaction in the second one. This student seems to have been involved in successful reflective assessment, reinforcing his experience with positive self feedback; in doing so he experienced satisfaction in his self-assessment and enjoyed the process.

Still another plausible reason can be seen in that concept mapping is a metacognitive activity. A metacognitive activity involves the thinking that takes place when one plans, monitors, or evaluates one's own learning. A metacognitive approach of self monitoring can help students determine their own learning goals and guide their progress in attaining those (Darling-Hammond & Bransford, 2005). This student was monitoring and evaluating his experience with the concept map and planning each step. Alkhatani K (2009) and Russell and Meikamp (1994) has also concluded that creativity training assisted students of varying abilities in developing metacognitive skills. They based their conclusion on the complexity of the maps produced by the students who were provided with creativity training. Results of the present study are in line with that by Alkhatani K (2009) and Russell and Meikamp (1994), showing that students who received creativity training produced more complex maps and outperformed those who did not receive creativity training.

### 7.1.3 Process of Creativity Training

The results of the present study may be explained through the findings of investigators like Stein 1975, Vengundy, Parnes 19687, Feldhusen 1988 & 1990, who asserted that some deliberate instruction or training can help people become better creative thinkers and creative problem solvers. Same is the most basic premise in the current thinking skills movement that students can learn to think better if schools concentrate on teaching them How to do So (Presseisen). In the same way using
creativity training program deliberately helped in training the students in the methods and strategies to think creatively.

Even Ristow, 1988, has asserted that direct teaching of thinking skills can produce better, more creative thinkers. The study gets further support from the study of Rao (1994) who observed that creative abilities can be developed by providing proper experiences i.e. training had a significant positive effect on the performance of experimental group instructions in developing thinking skills.

Foremost aspect of the process of creativity training program is that it provides information about the methods to think creatively and the methods were quite flexible in this manner. The deliberate questions and the situations provided in program as a whole challenged the creative thinking of student and so resulted in fostering creative thinking in them. These results are at par with the statements of de Bono, the originator of this creativity training program. According to de Bono, “one should be free of constraints, tradition and history in order to be creative. But that freedom is more effectively obtained by using certain deliberate techniques rather than by hoping to be free”. McKim (1986) proposed that the conditions like challenge, information and flexibility can foster creative thinking that is productive and creative. The program in the present study fulfilled all these conditions. It is perhaps because of this, that the program could effectively develop the creative thinking of the students.

Another aspect of process of creativity training program may be that the program provided sufficient opportunities to understand the theory and concept of training program. It required sufficient time which was in consonance with the findings of Pogrow (1987) that it takes an extensive amount of time to produce results—at least 35 minutes a day, four days a week, for several months, for true thinking skills development to occur. Even De-Bono, 1970 stated that to set aside a definite period for teaching thinking is much more useful than trying to gently introduce its principles in the course of teaching some other subject. Nevertheless, once knowledge of creative thinking exists, the act of creative thinking could cross domains and disciplines while performing problems solving activities. De Bono has even suggested that one hour/week during the educational process may be adequate to infuse Creative Thinking. Once the tool is introduced and cognitively implemented, the emphasis would be to use the theory
throughout future work. The same hold true for the present study which introduced the creative thinking to students and made them implement it through exercise so that they can use it in future problems.

Still another plausible reason for enhancement of creative thinking is that program deals with creative challenge. Creative challenge is totally different from critical challenge. The creative challenge refuses to accept that the current way is necessarily the best way. The creative challenge assumes that the current way is just one way which happens to be there for a variety of reasons. The creative challenge is usually expressed as “why” “Why do we think in this way”? After one has made a creative challenge De Bono wants one to move on the next step which is to try to find alternate ways of doing things. Here in this method he explained three different ways to find alternatives. One way was to block the current path of ways of doing things. This forced students to find alternate ways. Secondly, in the tool ‘Random Idea’ one can escape from the dominating idea or from the necessity to satisfy some conditions. This forces the mind to consider new possibilities. The third alternative is ‘Random Input’ i.e. to drop any new alternative. If one challenges something and finds it not necessary, he may leave it. Such methods definitely help a person to think creatively.

One more reason for the effectiveness of the program may be that the program helped to remove the errors like partialism, adversary thinking, time scale error, initial judgment, arrogance and conceit which are the major hindrance to creative thinking. The thinker no more observe the problem through one’s perspective as being right or wrong only. The thinker examines many factors of the problem and avoids partialism by avoiding arriving at a premature solution. As the program trains students to challenge for change thus removing the time scale error. As the module trains a person to withhold the initial judgment so it helps in considering the issue or problem objectively, making the approach of the thinker free of prejudice or bias. Challenge for change helps in removing arrogance and conceit as after training, the thinker no more believes that there is no better solutions other than that he has already found. So the block to creativity as well as creative thinking is removed. It helped in enhancing creative thinking skills in the students.
Further, it can be noted that all the tools of thinking are simply the attention directing tools. As a self organizing system, mind allows incoming information to organize itself into routine patterns resulting in concept prisons and pattern first introduced by De, Bono, 1972. Human brain is habitual of making patterns. It is well trained to adjust new information in relation to old information and experiences. So a sort of sequence trap or a pattern is formed. This brings continuity in thoughts. So ultimately one ends up thinking in a very similar way. This could be the main reason that after training the students avoided obvious answers. Therefore the complexity of their concept maps increased tremendously after training.

7.1.4 Strategies of creativity training

Another explanation for the results of present study can be looked into the way of the different strategies of creative thinking which are organized under the three broad categories: CoRT I, CoRT IV, CoRT IV. These strategies were properly explained in the training session and students were trained in ways to apply them. CoRT I is a compulsory strategy to be taught to students as it is the basic step for learning creativity tools in better way. This part involves the use of various tools like PMI, FIP, Cs, Aims, Goals and Objectives etc. that can be practiced in day to day problem. For example when students were taught about PMI means Plus, Minus and Interesting of any problem, they were able to enhance the horizon of their thinking by thinking positive, negative and interesting aspects of any situation. After that, they were able to direct their attention for problem solving in better way. The second strategy CoRT IV explained various creativity enhancing tools like yes-no-po, random juxtaposition or random input, concept challenge, random input, dominant idea, escape. The effectiveness of this strategy lies in the connection making theory. In yes-no-po method, students are made to obtain a word that has no connection whatsoever with the problem and holds the problem and this word together. De Bono termed it as Po envelope. One of the functions of Po is to allow one to put together words or ideas in a way that would not be justified on any logical grounds. PO itself is the only justification. As some catalyst accelerate reactions just by holding reactants together, thinking also is accelerated by holding an idea and random word together. This ‘random input’ method works because our brain is quite good at making
connections. DE Bono asserts that there, seldom, is a problem to which that word is too remote. Instead it could often happen that the word is so closely to the focus area that there is little provocative effect. To avoid this, the random work should be selected by some methods. Especially while working alone. This random input technique is very good for producing new lines of thoughts and ideas that would never have been reached by any sort of logical design or analytical process. Mixing in an unrelated concept causes the brain to think in a different direction and come up with new links, combining previously unrelated ideas to form new one. This must have helped the students in producing more original ideas. Therefore, the creativity training program helped in increasing the complexity of concept maps. CoRT VI deals with tools like identification of problem, defining the problem, choosing the target and solving the problem. More or less this strategy looks like the basic steps of scientific method that allow one to move step by step to find out the solution to the existing problem. Scientific methods maintain hypothesis which are accepted or rejected on the basis of solution to the problem. These methods are not at once judgmental or pre-biased but based on a strong empirical foundation. Same has been stated by DE bono, 1995 that “Everyone knows that instant judgment is the enemy of creativity”, It isn’t necessarily that all judgment is wrong; it’s allowing the ideas to emerge without screening them out. It is repeatedly mentioned that there is a need for a quantity of ideas for a good one to emerge. That is what this creativity training program offered to the students. The program enhanced their thinking and they were able to use these techniques to consciously bring about a particular psychological state.

7.1.4 Principles of Creativity Training

The effectiveness of the training program can also be justified considering the basic principles of creative thinking. The first principle of creative thinking is background i.e. the need for creative thinking rises from the way the mind behaves as a patterning system which requires discontinuity in order to change patterns and bring them up to date. As the creativity training program also does the same so it could easily enhance creative thinking.
The second principle of creative thinking is *process*. Creative thinking is concerned with change; with escape from existing and dominant ideas and generation of new ones. As already mentioned, the training program provided escape from the obvious, so it could also be the possible reason for the effectiveness of the creativity training. Creativity training program had the two basic principles: escape and provocation both of which were integral parts of the program. The major stress of the Po method itself is on the conscious use of provocation. Provocation has everything to do with the experiments in the mind. Experiments in the mind have everything to do with the creative thinking. That is why good provocation is so important for being creative. We all know that a lot of new ideas come from mistake, accidents or madness. All these happenings force us from outside the usual boundaries of reasonableness that has been established through our experience. In provocation we move from the starting point to an arbitrary provocation. Then we move on from provocation to an idea or concept. Now looking back we can get the real value of the idea. The method thus helps to break from straight forward way of thinking. Instead of thinking linear, provocation helps in taking an altogether different direction of thinking. It is because of this that students became capable of escaping from the obvious answers.

The third principles may be the *method* which means the use of creative thinking consisting of an awareness of the patterning nature of mind, an appreciation of the difference between the rules of creative thinking, the application of special settings as techniques and of the rules of creative thinking, the application of special settings as techniques and of a new operational work. As the training program was used keeping in mind all the principles of creative thinking, this may also be the reason behind its effectiveness.

It can further be explained by two steps of tool ‘yes-no-po’ in training program as advocated by de Bono. The first step is called the escape method and the other is stepping stone method. Escape method is simple method where the first step is to spell out something that we take for granted. The next step is to escape from what we have taken for granted. This is the provocation that helps the students to escape from obvious/granted answer. Second method of making provocation explain by de Bono is called the stepping stone method. The main idea behind this is to carry out some
mechanical operation on something that already exists. One can make stepping stone provocation by exaggeration, wishful thinking. For this one simply puts forward a fantasy knowing that it is impossible to achieve, which helped the student teachers to escape from the obvious answers and in other words helped in increased scores in escape factor of lateral thinking. As lateral thinking will increase, it has an effect on creative thinking. And thus it becomes a plausible reason that concept mapping and scientific creativity is developed.

The results in the present study, about the effectiveness of creativity training program are also in consonance with the investigator like Sheridan (1990) who found brain research based writing programs to be very useful and appearing in developing lateral thinking skills and Weiss (1977) who studied techniques to improve thinking and suggested that the problem solving has some positive effect when implemented under typical class room situation. Further, the module gave exposure to different problems in a teaching learning environment. It was in accordance to Wagner (1999), who indicated that students when engaged in problem solving expanded their thinking skills.

Variety of instructional materials and programs, both short term and long term have been developed for training creative thinking, critical thinking, problem solving in educational settings though mostly in the west. One study was obtained which sought to apply the work of Edward de Bono to five kindergarten grade levels in Malta (Dimech and Pace, 2003). This work is based on the idea that divergent and creative approaches to problem-solving can be more successful than linear reasoning for developing ‘creative thinking’. In this study the children took part in age-appropriate exercises in creative problem-solving and the kindergarten staff considered that the intervention increased pupils’ self-expression and confidence. From the results of this study it can be said that the results of the present study fall in consonance with all these findings of Malta study.

Similar results were recorded in report of thinking skill instructional activities (mid-continent Regional Educational Laboratory, 1985) while examining the effects of training teacher in how to foster in their students aged 18 higher-order thinking skills in the three areas of learning: to learn skills, content thinking skills, and basic instruction on test performance and enabled students to become better problem solvers in other situations, both in and outside of school. Research here showed that different techniques
enhance the development of critical and creative thinking skills (Cotton 1988; Pearson 1982; Robinson 1987; Tenenbaum 1986). Baum 1990; Cotton 1988; Herrnstein, 11986; Matthews 1989; Robinson 1987; Stenberg and Bhana 1986 found Redirection/Probing/Reinforcement to effectively enhance the high order thinking. In the present research also, methods are adopted to redirect thinking in a new direction. This may be the plausible reason for enhancing the scientific creativity of the students as well as complexity in their concept maps.

Focusing ‘directly’ on thinking sharpens perceptions and creative thinking. For the same reason various techniques like generation of alternative, brain storming, finding analogies etc. have been explored in the recent times by different investigators and found to be effective. Cotton 1988; Hudigns and Edelman 1986; Pogrow 1988 found that asking higher-order questions enhance critical and creative thinking. The efficacy of direct instruction in a variety of thinking skills is demonstrated in the work of Freesman (1990); Herrnstein, et al. (1986); Pearson (1982); and Wong (1985) among others. The present study also adopted the ‘direct’ instruction to teach creative thinking skills instead of inferential method and found it effective i.e. training the students directly in creative thinking tools rather than just employing the activities for enhancing the creative thinking skills of students.

Another reason may be because of unique patterning system of thinking. de Bono (1972) asserted that our thinking has a unique pattern. It consists of two phases. Phase I is the perception stage. Perception gives us a way to look at the things or situation. Second stage comes after perception stage. It is called the processing stage. Generally we are concerned only with the thinking that comes after perception. We don’t pay heed to perception as we believe that there could be only one way to look at things. We are habitual of recognize patterns and reacting to them. These reactions come from our past experiences and logical extensions to those experiences. The program helps in changing the perceptions of the students and teaches them to look at the things with a new perspective. Therefore, it helps in providing them different ways to look at the problems. It also must be reason for increase in the scores of concept map after the training.

One more finding was about the effect of intelligence on the lateral thinking test scores. A significant effect of intelligence on the lateral thinking scores was noted in the
study. The result is explained through Skinner (1958) who found that the active participation was necessary for effective learning. These results are at par with those of Pathak (1962), Dhaliwal and Saini (1976), Dey (1984) who reported positive and significant relationship between intelligence and creativity. Researches like Sharma (1974), Joshi, (1974) and Chaudhary (1983) also reported positive and significant correlation between intelligence and creativity. Further the difference in the mean scores of middle and low intelligence group was very small. So we may conclude that although the high intelligence students tend to score better in concept map performance test yet intelligence is not a determinant of concept mapping ability. When the effect of intelligence was studied in relation to the effect of testing occasions, no significant difference in the test scores of different groups with respect to intelligence was reported. It may be observed that all experimental groups fared much better than their counterparts in control group irrespective of their intelligence. It is also to be noted that the mean scores of all three groups in experimental group were equivalent to their counterparts in control group. So, it can be concluded that the creativity training program was equally effective for all the students irrespective of their intelligence.

7.2 Effect of creativity training program on Scientific Creativity

The explanation for the findings regarding the effectiveness of creativity training program on scientific creativity can be seen in that scientific inventions or discoveries were affected by what a person did and how he or she perceived the world around him or her. The students who were given creativity training were having good post test scores in their scientific creativity test. The possible reason could be seen in the kind of different ideas that an individual dealt with. While creativity training sessions, the individuals were assigned firstly in groups and then individually to develop a new kind of thinking by changing his or her attitude to deal with ideas in different way yet creative one. In other words, the very kind of idea gets changed in the process. From this, he or she is driven to think particular idea otherwise called a personal idea. The whole process revolves around changing the existing idea and welcoming the new idea. The process also made the students to accept the coming idea as it is and not to make any judgmental statement on that idea. The training program helped students to rethink more and more
ideas that were very close to the individual. He or she left one idea and catches another one to pursue still another one. In this way perhaps the ideas were gathered and sequenced to make meaningful designs. Thus, the coming new ideas definitely stimulated the imagination of students and helped them to record their thoughts. So, this was a technique for churning the minds with novel vision and insight can rise to its surface. That’s why scientific creativity of students has enhanced.

Furthermore, the literature pertaining to the impact of creativity training on the enhancement of creative ability indicated that the results of the present study added to a growing body of research that validated the role of nurturing creativity through creativity training as an opportunity for increasing creative ability. The literature review also recommends creativity training as a successful practice to address the needs of students of varying abilities (Baum, 1990; Feldhusen et al., 1969; Khatena, 1971, 1973; Russell and Meikamp, 1994; Sternberg, 2003).

Another plausible reason can be seen in that while teaching the CoRT thinking lessons brainstorming, analogies, problem solving, questioning techniques and open-ended activities were used. Consequently, creativity training did benefit students who received it by enhancing their creative abilities (such as fluency, flexibility, originality, and elaboration) which resulted in their scores on the post-test in which they produced creative products on the scientific creativity test and created more complex concept maps by integrating information related to a key concept. Maps of the students in the experimental group (which received creativity training) point to a deep learning and understanding which resulted from the change in their learning strategies. The maps constructed by those students reflected changes in their conceptual understanding which was evidenced by a higher number of concepts, a higher quality of hierarchical organization of concepts, and a higher number of crosslinks. They used different thinking skills and learning strategies to read, understand, and map the story.

Results of both previous studies and the present study are in line with many theorists (e.g. de Bono, 1978, 1986; Gordon, 1961; Guilford, 1967; Renzulli, 2001; Renzulli, 1997; Runco, 2007; Sternberg, 2003; Torrance, 1962a, 1962b, 1963, 1965, 1967a, 1967b, 1977, 1993) who theorized that creativity can be taught and students do learn techniques which help them to enhance their creativity.
7.3 Relation between scientific creativity and concept mapping ability

Another finding of the present study is that there is a relationship between the scientific creativity scores and concept map performance test scores. Although the correlation was low but it was significant on .05 level of significance. This finding indicated that those students who created better concept maps also score better scores in the scientific creativity. Novak and Gowin (1984) and Novak's (1998) proposal that concept maps can be used to aid creativity supports this correlations found (in both the pre-test and post-test) between concept mapping and scientific creativity test. They argue that the process of creating a concept map is an activity that encourage and develop creativity. It is believed that Novak and Gowin's argument seems to stand up well.

The possible reason can be seen in that the concept mapping has been seen as an externalized representation of the learner’s knowledge (Dabbagh, 2001; Plotnic, 1997, Novak 1998; Novak and Gowin, 1984, Novak and Cañas, 2006a, 2006b). Concept mapping, therefore, might help children to develop more personal awareness of themselves as learners and their own knowledge. This awareness might lead to deeper levels of cognitive engagement which can result in a creative way of thinking and creative behavior. Furthermore, this finding might be explained under Ausubel's theory. To Ausubel, building hierarchical conceptual structures, and making unique associations across concepts at the higher levels in the conceptual structure is a creative behavior (as cited in Novak, 1977). Therefore, it can be argued that the correlation between concept map scores and scientific test scores may be explained by similarities between creativity as seen by Ausubel and concept mapping procedure.

Still another possible reason can be seen in comparison between concept mapping procedure and brainstorming proposed by Plotnic who stated that "as one puts ideas down on paper without criticism, the ideas become clearer and the mind becomes free to receive new ideas. These new ideas may be linked to ideas already on the paper, and they may also trigger new associations leading to new ideas" (1997, p. 3).

From the above written paragraphs it can be concluded that concept mapping ability is also a creative activity. That is why, there was found to be a positive correlation between scientific creativity and scientific creativity.
On the basis of above explanation and reason given in the preceding paragraphs show that the creativity training program was highly effective due to the active participation of students, simplicity, figural illustrations and day to day examples, interesting explanation and above all the novelty of concept mapping technique. On the basis of this discussion, it can be said that creativity training program as well as concept mapping technique in itself is such a process that helped to develop creative thinking skills among the students and leads one towards creativity.