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A Study on Creative Teaching Through Bioscience in Developing Creative Thinking Ability of Students

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Abstract:
Creativity is an important aspect of learning. Thanks to creativity, the student gains a positive attitude towards learning and becomes more fun to learn. Thanks to creativity, the student activates the passive information by converting it into a product. Thanks to the creativity, acquired at a young age, individuals can more easily solve their daily life problems and become more productive in adulthood. This is one of the main aims of education: to make the students
well equipped for their future life and to educate them as productive citizens. For this reason, the Ministry of National Education has taken the acquisitions in creative thinking education in schools. According to constructivism, adopted by the Ministry of National Education teachers do not teach in a democratic classroom climate but are leaders. Students express their thoughts freely and discover and produce the knowledge. Societies' development can only be improved in this way.

CHAPTER 1
INTRODUCTION

Background and Rationale of the study

Creativity is an important aspect of learning. Thanks to creativity, the student gains a positive attitude towards learning and becomes more fun to learn. Thanks to creativity, the student activates the passive information by converting it into a product. Thanks to the creativity, acquired at a young age, individuals can more easily solve their daily life problems and becomemore productive in adulthood. This is one of the main aims of education: to make the studentswell equipped for their future life and to educate them as productive citizens. For this reason, the Ministry of National Education has taken the acquisitions in creative thinking education inschools. According to constructivism, adopted by the Ministry of National Education teachersdo not teach in a democratic classroom climate but are leaders. Students express their thoughtsfreely and discover and produce the knowledge. Societies' development can only be improvedin this way.

Enhancing creative thinking ability of students through training in creativity had received attention in recent years. The human mind is capable of creating hundreds of ideas every day.The creative thinking is the gift exclusively to human beings that make it different from animal. Enhancement of creativity is a powerful tool to unite mankind and thus built new era of prosperity in the World. Development of creative ability among students, teachers, professionals and any individual society is need of hour for

sustainable development in the society. Professionals of all different areas are becoming aware of importance of creative thinking to improve their activities. In education creative thinking varies completely from new ideas to new ways of considering and solving problems. It has been said that creativity is not the the ability to create out of nothing, but the ability to generate new ideas by combining, changing or reapplying existing ideas. Creativity studies in education have been gaining momentum during last two decades. It was once thought only as an artistic quality and it has become sought after by engineers, executives and researchers now.

Contemporary society demands the focus of education to shift from "how to live '' in existingsociety to "How to adapt '' in emerging society. So human resource development programmeneed to accommodate it. Educational methods have to enable students to become sensitive to problems, to identify gaps, and missing elements in knowledge to formulate conjectures, to test retest and modify those conjectures to find solutions to problems.

Many Universities have been offering courses in creative problem solving, many engineers andbusiness companies have started creative programs for their professionals. Thus training in creative thinking has grown enormously during last decade of 20th century. In India most of the works on creativity had emphasized on construction of tests, correlation studies with achievement, Intelligence, personality, age, socio-economic status etc. There has been a little research on problem related to nurturing and promoting creative thinking especially in class room conditions. If school can develop thinking in minds of students, then they can achieve success during succeeding period of their life by contributing novel ideas to society.

What is Creativity?

Creativity is to provide effective thinking skills to students is one of the main objectives of education. Although there have been great changes in the field of education from Socrates to the present day, the effort to give students the ability to think has always been in the core of the education. Creativity is not a concept which has a simple definition. Creativity is the desire of the individual to find an original product or solution. The sense of desire and imagination are the key words of creativity. According to Sternberg and Lubart (1998), originality for creativity alone is inadequate. Torrance (1988) defined creativity as: "The process of sensing difficulties, problems, gaps in information, missing elements, something askew: making guesses and formulating hypotheses about these deficiencies; evaluating and testing these guesses and hypotheses; possibly revising and retesting them and finally communicating the results" (Bartscher, Lawler, Ramirez, & Schinault, 2001; Lubart & Sternberg, 1998).

Importance of Creativity

The importance of creativity as one of the essential skills in education has been widely acknowledged by politicians, policy makers, educators, and researchers. With such an emphasis on creativity in education, teaching for creativity has assumed increasing importance in school curricula. However, creativity instruction still prompts many problems and dilemmas. For example, lack of agreed-on definitions is a burden for educations and researchers alike. That is, school leaders and teachers do not have a clear understanding of what creativity means, along with lack of commonly used definitions or lack of descriptions of the term by researchersin creativity research .Their misconceptions or conceptual barriers may impede their efforts atfostering creativity in their classrooms.

Creativity is a multifaceted construct and there has not been a single, agreed-upon definition. The 4P's

conceptions, person, process, product, and press (environment), has been widely utilized in describing what constitutes creativity .Noting the lack of a commonly used definitionof creativity, Plucker, Beghetto, and Dow (2004) proposed one which consists of 4P'sconceptions: "creativity is the interaction among aptitude, process, and environment by whichan individual or group produces a perceptible product that is both novel and useful as defined
within a social context". This definition introduced two criteria — "novelty" and "appropriateness (usefulness)"— as key components of creative output. Another definition thathas been widely used was proposed by Sternberg and Lubart (1995): "creativity is the processof generating ideas that are novel and bringing into existence a product that is appropriate andof high quality."

Creative Thinking and Education

It is possible to divide creative thinking into two, like all other kinds of thinking: passive thinking and active thinking. At the end of passive creative thinking there is no action or concrete product. As a matter of fact, most people think in their minds and generate creative ideas every day and every time, but the creative ideas which are not implemented do not meanmuch.

There is an action, a performance after active creative thinking. This action can occur in a verydifferent structure: Works of creativity such as story, poetry, novel, drama, invention, design, painting, problem solving. Of course, the ability of creative thinking alone is not sufficient for the emergence of these products, but at the same time it is necessary to have at least a minimumability to embody the thought. It is possible to find a dilemma in a school where creative thinking culture is tried to be placed. Is school the place where creativity is taught, or is it where creative teaching is done? It is expected that teaching methods and techniques will be creative and innovative in a school that has the mission of educating students equipped with creative thinking skills.

Students should not be those who learn creativity as an external factor, but rather those who are in the creative environment and continue their education as part of the process. For this reason, a learning environment in which new methods are tried beyond traditional approacheswill be a more optimal place. Research on creativity has shown that humour has a positive effect on the ability to generate a greater quantity of ideas as well as to improve the quality ofcreative thinking in groups (Shade & Shade, 2016). However, teachers are transforming the learning environment to a more serious place to achieve both classroom management and completion of the curriculum. In addition, homework also aims to consolidate the lessons learned more than to develop students' thinking skills.

Creative Writing: An important part of creative thinking

One of the most important skills a school can provide to students is creative writing (Arthur and Zell, 1996). Creative writing is the pouring of thoughts and feelings onto the paper by reconstructing the existing information, concepts, events, sounds in the memory, images, smells, feelings and dreams and associating them with each other.

What are the aims of providing students with creative writing skills?

Some reasons can be seen below for giving creative writing skills as follows (Maltepe, 2006; Essex, 1995):

- To entertain the children,
- To develop artistic expressions of children,

- Discover the value and function of writing,
- Developing children's imagination,
- To ensure that students are open-minded,
- To teach reading and writing.

Although writing is a study in language lesson and literature courses, it is mostly seen as a waste of time in the learning environment based on multiple choice test system. Unfortunately,it would not be wrong to describe creative writing as one of the many targets that could not be reached within the educational program.

The creative writing process takes place in four stages:

- **Incubation period:** The most complex aspect of the writing work is the incubation period before the need for writing occurs. In this process, the individual reads a lot, takes notes, dreams and develops self-confidence.
- **Writing needs:** The individual needs to express his / her verbal expression skills in written way. The words, depictions, pictures, and stories that he has accumulated in his mind cling to each other like chains and attempt to transform from an abstract phenomenon into a concrete product.
- **Creative thinking:** The need for writing leads to a deep reflection on the stories raised in one'smind, internally debates, cause-and-effect relations and a new life in his inner world.
- **Creative writing:** Beginning with the need of writing and creative thinking process the products such as poetry, stories and fairy tales emerge in this way in simple terms.

Creative thinking skills for Bioscience students

Creativity is an elusive concept and can be interpreted in a variety of different ways. So is creativity in science domain. Creativity in science education may aim at developing scientificcreativity, as defined in Hu and Adey (2002) or some general creative thinking elements, as described in McCormack and Yager (1989). Creativity field is having an on-going debate on the domain-specificity and generality of creativity (Baer & Kaufman, 2005). This shed doubt on the transfer of creativity learning from science to other domains.

On the other hand, the suitability of developing creativity of scientists in a “science for all” curriculum is controversial. There is still no conclusion to what should be the teaching objectives and instructional strategies of creativity education in science. For these reasons, a multi-faceted perspective for integrating creative learning into science education is easier to be accepted than a unidirectional one. In a recent review of Kind and Kind (2007), they reported different perspectives in defining creativity in science education, and different approaches adopted by science educators, including poetry, inquiry-based science teaching, experimental methods, imagery and imagination.

Cheng (2006) suggested multiple approaches to foster creativity in Physics education, including discovery, understanding, presentation, application, and integration of science knowledge. For infusing creativity into regular lessons, one may need to consider the approaches of existing science curriculum. For long, science content-based and science process-based are the two most common approaches in science curriculum. Coming to recent decades, the science-technology-society (STS) approach grew in significance (Mansour, 2009). In parallel with these science curricula, this study suggests three approaches for integrating creativity into regular science lessons, i.e. developing creative thinking through scienceprocess, science content and science scenario.

The Lack of Creativity in Science Education

In K-12 school education, creativity has been traditionally associated with art and literature, although creativity in science has begun to be examined. In the early decades of the twentieth century, science courses failed to convey the role of 6 imagination and creativity in the learningof sciences.

Science pedagogy and textbooks for elementary curriculum mainly centred on surface learning, for example, asking students to witness the photos of science inventions or to observe and classify nature's objects. Likewise, traditional high school and university science programs were primarily geared toward aiding students in their mastery of knowledge rather than delivering the spirit or methods of science. For example, laboratory activities usually involved students repeating time-worn experiments, lacking the stimulation of the creative process.

In the mid-twentieth century, creativity was formally addressed in the field of educational psychology. After Guilford, creativity as an important attribute of school education gradually began to catch the attention of researchers and educators. Much research has been conducted on pedagogical techniques for developing students' creative-thinking abilities, but little of thisresearch has been purposely incorporated into science programs (Hadzigeorgiou et al., 2012; Rule, 2005).

Recently, STEAM programs, which integrate arts into STEM subjects (science, technology, engineering, and mathematics), have been adopted by many institutions and schools. The STEAM (with the "A" for arts) aims to foster creative thinking while infusing arts into the learning in STEM areas.

Some research articles indicate that arts-based teaching leads to motivated, engaged, and effective disciplinary learning in STEM subjects, but those studies rarely measure whether students' creative-thinking abilities are increased (Henriksen, 2014; Ko, An, & Park, 2013). Some STEM proponents suggest that STEM lessons should focus on developing rigorous math and science skills; these lessons should not be so much about teaching arts but applying arts inpractical situations, such as product design and decoration.

7 Art-based science instruction is one way to increase creativity in science; however, the promotion of creative thinking in science can be approached through different methods.

Is Creativity a Mental Phenomenon?

Creativity is a mental phenomenon that results from the application of ordinary cognitive processes such as working memory, and the ability to categorize and manipulate objects (creative cognition approach. Importantly, the ability to think creatively can be taught and developed—creativity is not a fixed inborn trait. However, this is often not what is happening in education. While the world has gone through revolutionary changes, teaching practices havenot changed much. The main focus in education is still on rote learning. In classroom activitiesas well as in the curricula, little attention is paid on introducing and practicing cognitive strategies proven to foster creative thinking skills.

By now, a variety of reports stress that creative thinking is a crucial 21st century skill and a skill that should be fostered in schools. Schools allow not only the training of a creative elite, but of our entire future generation. To illustrate, simply the way a question is asked can either stimulate or undermine creative thinking: Example 'What is three plus three?'

requires *convergent* thinking (i.e., finding the single, correct answer). However, if the teacher instead asks 'Which calculation will result in six', *divergent* thinking is stimulated—after all, the answer could be three plus three, two plus four, or twelve divided by two, and infinitely many others.

Instead of focusing on calculations, the teacher could also ask a broader question: 'What is six?' The

answer might be a triangular pyramid, the sixth sense, or an ice crystal. To boost creativity further, the teacher may ask 'What can you do with six?' Next day, she asks for answers. A dreamer or gifted visionary may answer: I see an array of hexagons, which you can use to build spaces. This example demonstrates that creativity is a skill that can be taught and developed within different academic domains and school subjects' .We can think of the brain as a muscle. To run a couple of kilometres, people must practice. By exercising regularly, ourmuscles and condition become strong enough to run a longer distance. It is no different for thebrain. Regular exercise is required to develop a creative thinking style and to keep our brain inshape.

A potentially helpful framework for fostering creativity in educational settings is the 4 P's model of creativity: how to promote the cognitive processes that lead to creativity (Process), how to recognize and support creative individuals (Person), how the school/classroom environment impacts creativity (Press), and how to recognize and evaluate creativity instudents' work (Product)

Or any problems faced by them in learning in everyday life. When the ability to think creativelydevelops it will give birth to ideas (ideas), find relationships that are

Interrelated, create and do imagination, and have many perspectives on things. Students who have high creative thinking skills tend to feel challenged and interested in solving various problems in learning. Interest in solving this problem also causes curiosity. In learning,curiosity is very necessary to obtain the relationship of concepts that have been learned and that are being studied, so as to solve the problems faced

Studies Conducted in India

- The present study has been conducted in G.B. Pant University campus, Pantnagar Udham Singh Nagar district of Uttarakhand on Creativity and Academic Achievement among School going children. The purpose of the study was to assess association between creativity, intelligence and academic achievement of children. A sample of 300 students was collected in the age group of 12-16 years (100 students each from class VII, IX and X) by simple random sampling technique. The data was collected through survey method using self-constructed questionnaire schedule to elicit information on general information of the respondents, their family income, information related to their study behaviour. The test of non-verbal test of creative thinking by Baquer Mehdi (1985) and Indian adaptation of Wechsler Adult IntelligenceScale by Ramalingaswamy (1972) were conducted. Data was analysed in terms of frequency and percentage. It was found that there is no significant association betweencreativity, intelligence and academic achievement.
- Dr.S.Candrasekaran conducted a study on Creativity and Academic Achievement of Higher Secondary School Students in Tamil Nadu. The students who participated in this study were all 11th and 12th students. The research questions posed for the study required the students to identify and analyse the distributions and correlations of certain creativity perception were best addressed in the form of a descriptive study. Creativity levels were assessed by self-report instruments and were confirmed by consideration ofthe results from the administration offices of the universities (described below). They were then divided by gender; with the total scores and subscales calculated for each male and female. The participant sample, women (18-27 years) and men (19-27 years),was asked to respond during the regular course time. Both written and oral instructions were given to all participants, and the subjects were ready to answer upcoming questions in the class. Multiple significance tests were conducted, and the data were analysed by t-test. Participants answered the

tests either using their name or anonymously (which ever they preferred). They received no rewards for participating but were advised they would be given information of their results in the form of a self. Referenced level of abilities at a later date, score for the creativity scale and its factors, were entered into the statistical program.

Studies conducted outside India

- Mustafa Şenel of Gaziantep University conducted in the fourth grade of a private primary school in the province of Gaziantep in the 2018-2019 academic year to provide students with creative thinking skills. This study was carried out as a qualitative case study. 23 students participated in the program. With a two-month study, students were given 23 journal writing topics to develop their creative thinking skills. The students wrote their journals in the school for 5-10 minutes at the beginning of the lessons. At the end of the program students and teachers were asked to write their opinions in the interview form. The data were analysed by NVIVO 12 for Mac. According to the findings, creative thinking and writing activities have a positive effect on students' development of creative thinking skills. Majority of the students think the program wasentertaining while it is seen that female students are more willing than male students.
- Abdullahi Naser Mohammad AlMutairi of Lebanese University investigated the effect of using brainstorm strategy in developing creative problem solving skills among male students in Saud Al-Kharji School in Kuwait. The sample of the study consisted of (98) male students. The sample was distributed into two classes, the first represents the experimental group totalling (47) students taught through brainstorming strategy within the course of developing thinking skills in the academic year 2012/2013, and the secondrepresents the control group totalling (51) students. The instruments of this study werea program to use brainstorming strategy and Torrance creative thinking test. Both validity and reliability were checked by the researcher. The findings of the study showed that there are statistical significant differences at the level of ($\alpha = 0.05$) between the experimental group and the control group in the total score and the sub scores of the creative thinking in the favour of the experimental group indicating the effectiveness ofusing brainstorming strategy in developing creative thinking skills. The researcher recommended the use of this strategy in the Kuwait schools.
- Tatang Herman of Indonesia University of Education, Bandung, Indonesia aimed to describe enhancement and achievement of students' Creative Thinking Skills in Mathematics (CTSM) as a result of 5E Learning Cycle with Metacognitive Techniques (LCM). This research used a quasi-experimental design with pretest-posttest control group. The population of the research is Junior High School students in Indramayu City, Indonesia. The sample is eighth grade students from two school levels, amounted to 173 students. The instruments used were consisted of CTSM tests and observation sheet. The study reveal that in terms of overall and in all school level, the enhancement and achievement of students' CTSM who received LCM is better than those who received 5E Learning Cycle (LC) and Conventional Learning (CL). Likewise the enhancement and achievement of students' CTSM who received LC is better than thosewho received CL. there is no interaction effect between learning model and school leveltowards enhancement and achievement of students' CTSM.
- Danielle E. Kaplan of California School of Education, Alliant International University, and San Francisco, United States of America conducted a study on critical thinking and participants were students enrolled in online critical thinking in teaching and learning courses at a California school of education over the course of several Terms. Twenty- one of sixty students volunteered to include

their work in the study, five male and 16 female. The participant body was composed of teachers and teachers in training of multiple ethnicities on intern and student teaching tracks in special education, single subject in varying subject areas, multiple subject credentials, and Teaching English as a Second Language (TESOL). Participants included two Multiple Subject candidates, fourteen Single Subject candidates including two in Math, two in English, three in Physical Education, two in Science, two in Language, two Educational Specialists, two undeclared, and one TESOL candidate. Selection was determined by required participation in the D. E. Kaplan DOI: 10.4236/psych.2019.102012 142 Psychology course and volunteering for the study. The volunteers were representative of the courseparticipants and teacher candidates in the school.

Critical Appraisal:

From all the above 7 review of related literatures, three has been done in India and the rest hasbeen done in outside India. Few of the studies has been done on different subjects and not only restricted to Biosciences and even the age group of the students have been varied. In India most of the works on creativity had emphasized on construction of tests, correlation studies with achievement, intelligence, personality, age, socio-economic status etc. There has been a little research on problem related to nurturing and promoting creative thinking especially in classroom setting. If school can develop creative thinking in minds of students, then they can achieve success during succeeding period of their life by contributing novel ideas to society. Thus in this study the researcher has tried to find out the effect of creative discussion approach of teaching bioscience on development of creative thinking ability of students.

Statement of the problem

Creativity studies in in Education have been gaining momentum during the last two decided. Itwas once thought only as an artistic quality and it has become sought after by engineers, executives and researches now. But this most important strategic tool has been, less nurtured amongst the student. The main reason behind this rote learning and competition. Hence Creative thinking is gradually diminishing and its utmost important that we inculcate the habitof same amongst the potential students.

Creative thinking can be a novel way of seeing and doing things characterized by four components- Fluency, Flexibility, Originality and Elaboration. It helps a lot to cope with the rapidly changing World in current society by improving thinking skills and not by mere specific knowledge in the era of information. Creative thinking is a novel way of seeing and doing things which is characterised by four components such a fluency, flexibility, originality and elaboration. Hence the title of the Research is "**A Study on Creative teaching through Bioscience in developing creative thinking ability of students".**

Operational Definition of the Key Terms:

a) **Creative Thinking-** Creative thinking means thinking outside the box. Often, creativity involves lateral thinking, which is the ability to perceive patterns that are not obvious.[2]Creativethinking might mean devising new ways to carry out tasks, solve problems, and meet challenges. It means bringing a fresh, and sometimes unorthodox, perspective to your work. This way of thinking can help departments and organizations like schools be more productive.

b) **Data Analysis- Data analysis** refers to a process of cleaning, transforming, and modelling data to discover useful information for business decision-making. The purpose of DataAnalysis is to extract

useful information from data and taking the decision based upon the dataanalysis.

c) **Jalota's Group Test**- A point scale of general ability for college students consists of 100items and the time for administration is 25 minutes.

Objectives

1. To find out the effect of creative discussion approach of teaching bioscience ondevelopment of creative thinking ability of students.
2. To compare difference in gain scores of creativity of subjects between experimentalgroup and the control group.
3. To find out the difference in bioscience achievement scores of subjects of two groups.
4. To determine difference in scholastic achievement scores of two groups.

Hypotheses

H1: There is no significant difference between the effects of creative discussion approach and conventional method of teaching bioscience on development of creative thinking ability of students.

H2:-The Gain scores in total creativity of group taught bioscience through creative discussion approach is significantly higher than that of the control group taught by conventional method.

H3:-The training in creativity through bioscience by creative discussion approach produces significantly higher achievement in science than the conventional method.

H4:-The experimental group obtains higher posttest scholastic achievement scores than the conventional group.

Delimitations

1. The present study will be delimited to Central Board of Secondary Education Only.
2. It will be conducted on one Co-Ed school and one purely Girls' based schoolsituated in Salt Lake City.
3. The present study will be delimited to class IX students only.
4. The sample of the study will be delimited to 150 students only.

Significance of the Study

In the study the Researcher wanted to teach bioscience through creative discussion method in the experimental group to develop creative thinking ability of the students. This study was a breakthrough of the stereotype lecture-oriented teaching as such studies give very lesser chances to discover the creative potentials of the children. The discovery and development of the creative genius among pupils were the prime focus of the education system and to focus this implication of creative thinking this study could be a good exemplary research work in shaping an overall wellbeing of the students.

CHAPTER 2
REVIEW OF RELATEDLITERATURE
INTRODUCTION

The review of literature is an important as any other component of research process. It involves the systematic identification, location and analysis of documents containing information related to the research problems. The major purpose of reviewing the literature is to determinethe study already been

done that relates to one's problem. Another important function of reviewis how it helps in planning the present work or the resources, and specific procedures and meaning instruments that have been opted for this work. Being familiar with previous researchalso facilitates interpretation of the results of the study. Finally these reviews give information which can either support or challenge the conclusions of the investigator's research and therefore provide clues to later research.

MEANING OF THE RELATED STUDY

Study of the related literature implies locating, reading and educating reports of research as well as reports of casual observation and opinions that are related to the individual's planned research project.

NEED FOR THE REVIEW OF LITERATURE

A thorough survey of literature can be of great help to the investigator to understand the problem from different dimensions. It enriches the study. It gives necessary insight to the research study by which one can think creatively.

PURPOSE OF THE REVIEW

1. The review of related literature enables the researcher to define the limits of his field.
   It helps the researcher to delimit and define his problem. The knowledge of related literature brings the researcher up-to-date on the work which others have done and thusto state the objectives clearly and concisely.
2. By reviewing the related literature the researcher can avoid unfruitful and useless problem areas. He can select those areas in which positive findings are very, likely to result and his endeavours would be likely to add to the knowledge in a meaningful way.
3. Through the review of related literature the researcher can avoid unintentional duplication of well-established findings. It is no use to replicate a study when the stability and validity of its results have been clearly established.
4. The final and important specific reason for reviewing the related literature is to know about the recommendations of previous researchers listed in their studies for further research.

The world and society are advancing at a remarkable pace. We need to equip ourselves with The ability to adapt to this trend, not to hold back. We can achieve great success by facing Challenges and responding to them with a new way of thinking and self-confidence. The abilityto apply creative thinking in both a digital and non-digital environment has become acharacteristic of successful people nowadays. Information technology is rapidly developed in the 21st century, and innovative thinking, problem-solving, or critical thinking ability is the critically preliminary ability of world citizens in diversified societies.Human resourcedevelopment in past years therefore stresses the creative Thinking skills.

According to Sternberg and Lubart (1996), creativity refers to the capacity for coping with a given problem in authentic ways. Such capacity is about looking at a specific situation and problem from different perspectives. Creativity is beyond creating out of nothing since a new idea or thought is often a variation version of an older thought or a combination of thoughts known or possessed previously. Thus, creativity can be defined as synthesizing previous thoughts and redefining previous thoughts (Bessis 1973). Creativity is a basic skill included inall aspects of human beings' life and the evolution of human beings (San 1985). According to Torrance (1974), creativity is "being sensitive to problems,

insufficiencies, shortage of information, non-existent elements and incompatibility; identifying challenges, seeking for solutions, estimation and hypothesizing or modifying hypothesizes in relation withinsufficiencies, selecting and trying one of the solutions, retrial, and concluding accordingly"

According to Steve Jobs creativity is just concerning things. When you ask creative people howthey did something, they feel a little guilty because they did not really do it, they just saw something. It seemed obvious to them after a while. That is because they were able to connectexperiences they have had and synthesis new things. Moreover, the reason they were able to do that was that they had had more experiences, or they have thought more about their experiences than other people have. After that, we have to understand that creative thinking isa skill we need to improve primary on. We have to be ready to break the patterns and traditionalway of thinking to be ready to start thinking in a creative way.

The way that's go to facilitates you to create a brand new approach to a selected situation or an issue. Starting with this method too soon guarantees more experience as you learn from many various examples, as you become grownup. So Creative thinking is: A way of observing problems or situations from a fresh perspective that means unorthodox solutions (which may look unsettling at first).

Creative thinking are often stimulated both by an unstructured process like brainstorming, and by a structured process like heuristic program. Moreover, it can be mean observing something during a new way. Often, creativity during this sense involves what's called heuristic program,or the power to perceive patterns that aren't obvious. At the best level, "creative" means bringing into being something that was not there before and has been brought into being. The word "creativity" covers a large range of various skills. Creative skills needed to alter conceptsand perceptions.

In most descriptions of problem-solving, there's usually a step called "search for alternatives". This suggests that creativity is required during this step. Creativity is poorly understood and difficult to show but there are positive techniques that everybody can learn. Edward de Bono notes creative techniques like focus, challenge, alternatives, concepts, etc. De Bono, E. (1993). Creativity should take its place alongside our other methods of handling information. Someonesitting down with the deliberate intention of generating a concept in an exceedingly certain area then proceeding to use an ingenious thinking technique systematically should represent a traditional state of affairs .Creative thinking will make an individual move "sideways" to undertake different perceptions, different concepts, and different points of entry. They will usevarious methods including provocations to resolve the issues. Creative thinking has considerably to try to do with perception to place forward different views. The various views are not derived each from the opposite but are independently produced. During this sense, ability must do with exploration even as perception must do with exploration.

Idea fluency is that the ability to come up with a large number of ideas from which to settleon. Research has indicated that the more ideas one has the greater is that the likelihood of finding a usable solution. Delaying evaluation of the ideas during the method of generating ideas can facilitate idea fluency. Students can make notes, records their observations and opinions of problems during thanks to assist within the process of idea fluency.

A distinct way of developing idea fluency is to use special times or locations during whichstudents tend to create a discussion during a creative way.

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descriptive study. Creativity levels were assessed by self-report instruments and were confirmed by consideration of the results from the administration officesof the universities. They were then divided by gender; with the total scores and subscales calculated for each male and female. The participant sample, women (18-27 years) and men (19-27 years), was asked to respond during the regular course time. Both written and oral instructions were given to all participants, and the subjects were ready to answer upcoming questions in the class. Multiple significance tests were conducted, and the data were analysed by t-test. Participants answered the tests either using their name or anonymously (which ever they preferred). They received no rewards for participating but were advised they would be given information of their results in the form of a self. Referenced level of abilities at a later date, score for the creativity scale and its factors, were entered into the statistical program.

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Abdullahi Naser Mohammad AlMutairi of Lebanese University investigated the effect of usingbrainstorm strategy in developing creative problem solving skills among male students in Saud Al-Kharji School in Kuwait. The sample of the study consisted of (98) male students. The sample was distributed into two classes, the first represents the experimental group totalling

(47) students taught through brainstorming strategy within the course of developing thinking skills in the academic year 2012/2013, and the second represents the control group totalling

(51) students. The instruments of this study were a program to use brainstorming strategy and Torrance creative thinking test. Both validity and reliability were checked by the researcher. The findings of the study showed that there are statistical significant differences at the level of ($\alpha = 0.05$) between the experimental group and the control group in the total score and the subscores of the creative thinking in the favour of the experimental group indicating the effectiveness of using brainstorming strategy in developing creative thinking skills. Theresearcher recommended the use of this strategy in the Kuwait schools.

Ida Madyaniandhis co-workers conductedacreativethinkingabilitytest on somehighschoolstudents. This study aimed to determine the profile of junior high schools students' creative thinking skills in learning science. Science is one of the subjects that require creative thinking skills. The method used in this study is descriptive analysis. Data were collected through a test, observation sheets, people, medium thinking ability level of 46 people and a low level of creative thinking skills of and interviews. Subjects in the study were 126students from four different junior high schools. The results of this study show that showed students who have high score are amount to 22 58 people and the percentage of each indicator on creative thinking from test were thinking fluently is 82%, thinking originally is 38%, thinking flexibly is 61% and thinking of elaboration is 55% while on observation sheets were thinking fluently is 71%, thinking originally is 40%, thinking flexibly is 63%and thinking of elaboration is 59%

Another study was conducted by a team of researchers from Universitas Negeri Malang, INDONESIA. The samples of the research were 96 students from three classes spreading across three junior high schools in Kediri, Indonesia. The data on students' creative thinking skills were taken from an essay test on science learning assessed using a creative thinking skillsrubric. The results of the research showed that there was a difference in students' creative thinking skills for different models. The highest creative thinking skills were exhibited by the students taught using the DSIMM model. The results of the research also showed that there was a difference in creative thinking skills between the male and the female students. The malestudents had higher creative thinking skills than the female students. This was presumably because in the differences of brain anatomy affecting the students' pattern of learning and activities.

Tatang Herman of Indonesia University of Education, Bandung, Indonesia aimed to describe enhancement and achievement of students' Creative Thinking Skills in Mathematics (CTSM) as a result of 5E Learning Cycle with Metacognitive Techniques (LCM). This research used a quasi-experimental design with pretest-posttest control group. The population of the research is Junior High School students in the Indramayu City, Indonesia. The sample is eighth grade students from two school levels, amounted to 173 students. The instruments used were consisted of CTSM tests and observation sheet. The study reveal that in terms of overall and in all school level, the enhancement and achievement of students' CTSM who received LCM is better than those who received 5E Learning Cycle (LC) and Conventional Learning (CL). Likewise the enhancement and achievement of students' CTSM who received LC is better than those who received CL. There is no interaction effect between learning model and school level towards enhancement and achievement of students' CTSM.

Danielle E. Kaplan of California School of Education, Alliant International University, and San Francisco, United States of America conducted a study on critical thinking and participantswere students enrolled in online critical thinking in teaching and learning courses at a California school of education over the course of several Terms. Twenty-one of sixty studentsvolunteered to include their work in the study, five male and 16 female. The participant body was composed of teachers and teachers in training of multiple ethnicities on intern and studentteaching tracks in special education, single subject in varying subject areas, multiple subject credentials, and Teaching English as a Second Language (TESOL). Participants included twoMultiple Subject candidates, fourteen Single Subject candidates including two in Math, two inEnglish, three in Physical Education, two in Science, two in Language, two Educational Specialists, two undeclared, and one TESOL candidate. Selection was determined by required participation in the D. E. Kaplan DOI: 10.4236/psych.2019.102012 142 Psychology course and volunteering for the study. The volunteers were representative of the course participants and teacher candidates in the school.

Another study on creative thinking was conducted in G.B. Pant University campus, Pantnagar Udham Singh Nagar district of Uttarakhand on Creativity and Academic Achievement among School going children. The purpose of the study was to assess association between creativity, intelligence and academic achievement of children. A sample of 300 students was collected in the age group of 12-16 years (100 students each from class VII, IX and X) by simple random sampling technique. The data was collected through survey method using self-constructed questionnaire schedule to elicit information on general information of the respondents, their family income, information related to their study behaviour. The test of non-verbal test of creative thinking by Baquer Mehdi (1985) and Indian adaptation of Wechsler Adult Intelligence Scale by Ramalingaswamy (1972) were conducted. Data was

analysed in terms of frequency and percentage. It was found that there is no significant association betweencreativity, intelligence and academic achievement.

Another study was conducted by Devika R., Assistant professor of NSS Training College**.** Thestudy was conducted using the normative survey method. The sample for the present study consisted of 640 secondary school students from different schools of Palakkad district. A tool, namely Critical Thinking Ability Test for Higher Secondary School Students was constructedand standardized by the investigators for the study.

The study investigated the influence, the effect of gender, type of management and the optionalsubject on the critical thinking ability of higher school students. Statistical measures such as t- test and ANOVA were used to analyse the data. The result of the analysis shows that a significant difference exists in the mean scores of critical thinking ability with respect to gender, type of management and optional subjects of students.

CHAPTER 3
RESEARCH METHODOLOGY

Creative thinking encourages students to use a variety of approaches to solve problems, analyse multiple viewpoints, adapt ideas, and arrive at new solutions. Sometimes it is referred to as divergent thinking. Strategies can be introduced using direct instruction in creative problem solving models and creative thinking processes. The processes are generally considered to be fluency, flexibility, originality, and elaboration. For the purpose of present study all the data were analysed using T-test and pooled variance to find out the effect of training on creativity and achievement sources.

Research Method

In this present study both qualitative and quantitative research design was used to carry out the research work.

Population of the study

The population of the study was limited to a group of male and female school students in Salt Lake, Kolkata.

Sample of the Study

The target population of the study was 120 boys and girls of class IX under the age group of 14-16 years from Kolkata, West Bengal. Out of which 65 girls and 55 boys.

Tools and Techniques for data collection.

- **Jalota's Group Test of General mental Ability was used to measure intelligence.**

This intelligence test is group verbal test which has been design by Dr. S.S. Jalota. By this test we can measure the intelligence of a group and classify in intelligent, average and dull categories. The test consist 100 questions with multiple choice and the students should choose one answer among the given options. The test has five separate categories of 20 tasks – vocabulary, classification, number series, analogies and reasoning. The items are mixed. This test was designed in 1951, then revised form published in 1960 and 1963.

- **Mehdi's Verbal test of Creative Thinking**

This was administered to find out the total creativity scores. A bioscience achievement test prepared by the investigation with content validity and coefficient reliability of 0.74 was used to measure achievement scores.

This test was developed by Dr. Baqer Mehdi. It has been published by National Psychological Corporation, Agra. There are four verbal and three non-verbal sub-tests under this. This verbal form has the following four sub-tests.

1. ***Consequence Test*** (duration 12 minutes). In this test, the subject is asked to think of as many consequences as possible for situations like-
2. What would happen if we could fly like a bid?
3. What would have happened if your school had wheels?
4. What would happen if you do not have any need for food?
5. ***Unusual uses test*** (duration 15 minutes). It includes test items like-Write as many novel,interesting and usual uses for objects like a piece of stone, a wooden stick, water.
3. ***New relationship test*** (duration 15 minutes). It has the test items like below.

Think of as many relationships between the following pairs of words, as possible.

1. Tree, house
2. Chair,
3. ladder
4. Air, Water

4. ***Product improvement test*** (duration 6 minutes).

Procedure for Data Analysis

Samples were divided into two groups-one is experimental group (Group A) and control group(Group B) with equal number of students under each group as given table 1.

	Group A (Experimental Group)			Group-B (Control Group)		
	Girls	Boys	Total	Girls	Boys	Total
School I	12	28	40	12	28	40
School II	25	Nil		25	Nil	25

Table 1:-Break Up of students in Experimental and Control Group

Students irregular in attendance were excluded from the study. Both the groups were matched well in respect of their intelligence and previous achievement before onset of the experiment. There was no significant difference in intelligence and science achievement scores between two groups. Mehdi's verbal test of creative thinking was administered before the experiment to both the groups to record the pre- test scores. The researcher had taught the bioscience chapters to Group A of each school through creative discussion approach for 20 weeks. The Science teacher of the class taught same topics by conventional method as usual in the control group. After the completion of the experiment, Mehdi's

Verbal Test of Creative Thinking wasadministered to both the groups to get post test scores. Total marks obtained by students in theannual examination was considered as scholastic achievement.

CHAPTER 4
ANALYSIS AND INTERPRETATION

Introduction

The research work is not complete merely by the collection of the data, in fact analysis and interpretation of data is also an important step of research work.

"Tabulation is simply the recording of the number of the types of responses in the appropriate categories".

It is truism and weighty statement that the raw scores hardly carry any significant results unlessthey are interpreted and generalized in a proper way. The objective of the investigator remainsunrealized without the interpretation and the analysis of the bars facts and material collected through the tools used for the study. Since it is only through generalization and interpretation that the researcher can reach certain conclusion, the objective of the chapter is the analysis of data, which implies the study of the tabulated material in order to determine the inherent factors or meaning. It no doubt helps in breaking down the existing complex factors into simple parts and put the parts together in the new arrangement for the purpose of interpretation.

S.P. Sukhia

After data is processed it has to be analysed for testing the significance of the hypothesis framed. Analysis is a process enters into research in one form or the other, from the very beginning in the selection of the problem, in the determination of methods and in interpreting and in interpreting and drawing conclusions from data gathered. Analysis of data means studying the organized material in order to discover inherent facts. The data are studied from as many angles as possible to explore the few facts.

Analysis requires an alert, flexible and open mind. It is worthwhile to prepare the plan of analysis before the actual collection of data. Good, Barr and Scates (1941) suggest four helpful modes to get started on analysing and the gathered data.

To think in terms of significant tables that the data permit.

To examine carefully the statement of the problem and earlier analysis and to study the originalrecords of the data.

To get away from the data and to think about the problem in layman's terms or to actuallydiscuss the problem with others.

To attack the data by making various statistical calculations.

Interpretation is the final phase of analysis process. According to Carter, V. Good, A.S. Barr and Douglas. E. Ecates, the process of interpretation is essentially one of the stating what the results show, what they mean, what their significance is and what the answer to the original problem is. Interpretation is thus by no means a mechanical process. It calls for a critical examination of the results of one's analysis in the light of all the limitations of data gathering. It is the most important step in the total procedure of research. The analysis and interpretation of data both together represent the application of inductive and deductive logic to the research process. The data are first classified by division into subgroup and are then analysed and synthesised in such a way that hypothesis may be verified or rejected. The final result may bea new principle or generalization.

Interpretation of the qualitative data is more dependent on the researcher's research skills,research background, creativity and biases.

Need of Interpretation

It is through interpretation that the researcher can well understand the abstract principle that works beneath his findings. Interpretation leads to the establishment of explanatory concepts that can serve as a guide for future research studies.

Research can better appreciate only through interpretation what are his findings and can make others to understand the real significance of his research findings.

The interpretation of the finding of exploratory research study often results into hypothesis for experimental research.

Technique of Interpretation

The technique of interpretation often involves the following steps:-

1. Researcher must give reasonable explanations of the relations, which he has found and he must interpret the lines of relationship in terms of the underlying processes.
2. Extraneous information must be considered while interpretation the final results of research study it may prove to be a key factor in understanding theproblem under consideration.
3. It is advisable before reaching upon final interpretation to consult expert someone which will lead to a result in correct interpretation and thus will enhance the utility of research results.
4. Researcher must accomplish the task of interpretation only after considering all relevant factors affecting the problem to avoid false generalization.

Classification

Most research studies result in a large volume of raw data which must be reduced into homogenous group, if we are to get meaningful relationships. This fact necessitates classification of data which happens to be the process of arranging data in groups or classes on the basis of common characteristics. Data having common characteristics are placed in one class and this way the entire data get divided into a number of groups or classes.

When a mass of data has been assembled, it becomes necessary for the researcher to arrange the same in some kind of concise and logical order. This procedure is referred to as tabulation. Thus, tabulation is the process of summarizing raw data and displaying the same in compact form for further analysis. In a broader sense tabulation is an orderly arrangementof data in columns and rows.

Tabulation is essential because of the following reasons:-

1. It conserves space and reduces explanatory and descriptive statement to aminimum.
2. It facilitates the summation of items and the detection of errors and omissions.
3. It facilitates the process of comparison.
4. It provides for various statistical computations.

Statistical Analysis

The significance of difference in pre-test and post-test correlated mean scores were tested byT-test to find out effect of training on creativity and achievement scores .The T-value between gain scores was found out using pooled variance.

1. Creative Discussion Approach versus Conventional Method

The first hypothesis tests creative thinking ability of subjects in two groups. But creativity is ameasure of fluency, flexibility, originality. So post scores of these three components between approaches of teaching are compared individually to arrive at conclusion. The mean score, standard deviation and t value of pre-test and post test results fluency, flexibility and originality and total creativity of both experimental group and control group has been presented in Table 2.

Table 2:- Mean, Standard deviation and t- values of Pre-test and Post test scoresof total creativity of Creative Discussion Approach (Group-A) and Conventional Method (Group B)

Gr		Girls						Boys					
	Components	N	M Pre	S.D.	M Post	S.D.	t-value	N	M Pre	S.D.	M Post	S.D.	t-value
School-1(Hariyana Vidya Mandir)													
A	Fluency	12	44.02	8.09	65.22	11.85	2.464	28	37.38	12.78	61.52	11.62	2.347
	Flexibility	12	23.14	6.27	38.86	8.60	2.334	28	25.32	7.24	38.95	9.52	2.201
	Originality	12	16.48	4.70	30.52	8.27	2.390	28	16.05	7.11	30.50	8.48	2.398
	Creativity	12	86.61	17.28	132.58	31.15	2.222	28	79.75	23.18	130.99	24.87	2.173
B	Fluency	12	38.94	9.28	43.05	8.20	0.527	28	41.39	11.36	46.37	12.33	0.453
	Flexibility	12	18.80	5.89	21.24	10.28	0.285	28	22.62	6.37	20.70	7.08	0.259
	Originality	12	12.98	5.05	10.46	7.08	0.436	28	13.22	6.37	11.92	7.5	0.168
	Creativity	12	70.72	15.22	75.75	25.60	0.191	28	76.23	30.56	78.99	28.60	0.085
School II- Our Lady Queen of the Mission													
A	Fluency	25	35.05	10.65	59.08	12.30	2.642						
	Flexibility	25	24.52	8.72	37.90	9.18	3.423						
	Originality	25	14.27	6.08	28.25	6.05	3.352						
	Creativity	25	71.84	25.30	123.22	37.28	2.349						
B	Fluency	25	32.67	9.80	37.14	9.25	2.345						
	Flexibility	25	17.52	7.35	16.09	8.95	0.380						
	Originality	25	12.77	7.08	15.08	8.10	0.169						
	Creativity	25	65.07	20.75	68.80	16.22	0.448						

The t value between post-test and pre-test fluency scores of two groups were 2.462 and 2.643 in girls and 2.339 in boys which were significant at 0.05 level of significance. However it is not significant in control group. It indicated that there was significant difference in mean fluency scores of both girls and boys taught through creative discussion approach.

The t-value between post-test and pre-test flexibility scores between experimental and control groups were 2.334 and 2.425 in girls and 2.201 in boys which were significant ($P<0.05$).But itis not significant in control group. So it can be inferred that was a significant difference in meanflexibility score of subjects taught through creative discussion method.

The t value between post-test and pre-test originality scores of two groups were 2.390, 2.352 and 2.397

in boys which was significant (P <0.05) .But t-value is not significant in control group. It implied that there was significant difference in originality score of two groups.

Thus, the mean scores in fluency, flexibility, originality in post-test were found different (P<0.005) in experimental group than the control group.

Table 3: Mean, Standard Deviation and t values of Gain in total creativity of CreativeDiscussion Approach (Group A) and Conventional Method (Group B).

School I- Hariyana Vidya Mandir.

	Girls						Boys					
		Group A		Group B				Group A		Group B		
Components	N	M	S.D	M	S.D.	t-value	N	M	S.D.	M	S.D.	t-value
Fluency	12	22.10	8.17	4.11	3.87	5.948	28	23.14	13.15	5.98	3.65	6.654
Flexibility	12	16.73	10.78	3.45	2.02	4.229	28	14.65	8.42	-1.92	1.40	10.336
Originality	12	15.04	12.08	-2.52	1.90	5.103	28	13.45	7.13	-1.30	0.87	10.866
Creativity	12	51.98	19.70	4.03	3.05	8.582	28	51.24	20.50	2.76	1.67	12.472

School II- Our Lady Queen of the Mission

Fluency	23.02	13.85	4.47	3.63	6.333	25
Flexibility	15.48	10.52	-2.56	2.28	7.88	25
Originality	14.98	11.28	-2.25	1.98	5.609	25
Creativity	51.39	24.52	3.18	1.95	9.119	25

N= Sample Size, M= Mean of Gain Score, S.D= Standard Deviation

As per the table, the t values of post-test and pre-test of total creativity scores of two groups were 2.221 in girls and 2.174 in boys which was significant at 0.005 level of significance. However, such values were not significant in control group. So it can be concluded that training in creativity had resulted significant difference in creative thinking ability of students taught through creative discussion approach than the control group taught by conventional method.

2. Gain score in Creativity in two groups.

The second hypothesis test gain in creative ability of experimental and control group which in turn is related to gain in fluency, flexibility, originality and total creativity scores. The mean gain, standard deviation and the t value of two groups in respect to fluency, flexibility, originality and total creativity are presented in Table 3.

It was found that the t value of gain in fluency score was 5.945 and 6.333 in girls whichis significant at 0.01 level of significance and that of boys was 6.656 which is also significant (P<0.001).It indicated gain in fluency was significantly higher in experimental group than the control group.

The t value of gain in flexibility score of two groups were significant (P<0.01) in girls(4.229 and 7.877) and boys (10.337). So, it can be inferred that gain in flexibility was significantly higher in experimental group.

The t value of gain in originality scores of two groups were also significant (P<0.01) ingirls (5.103 and 5.508) and boys (10.867) indicating significantly higher gain inexperimental group.

The t value of gain in total creativity scores of two groups were found as 8.582 and 9.019 in girls and 12.473 in boys which were significant (P<0.01).So it can be concluded that the gain in creativity of subjects taught through creative discussion approach was significantly higher than the control group taught by conventional method. So the second hypothesis is accepted. Results of the present work that training creative thinking ability has significant positive effect on creativity of subjects in experimental group is in agreement with earlier works.

3. Training and Science Achievement

Achievement in the area of education is very important for children especially during adolescence. Educational achievement has become an index of success in the highly competitive World. So its relation with creativity should be studied in research studies. I made a test in bioscience that was administered soon after the completion of training on creativity to compare score of two groups. Subsequently achievement scores in science in annual examination of subjects of experimental group was compared with the control group. The mean gain, standard deviation and t value of two groups are given in Table 4.

	Girls						Boys					
		Group A		Group B								
Components	N	M	S.D	M	S.D	t-value	N	M	S.D	M	S.D	t-value

Table 4:- Post-test Teacher made Science Achievement (TMSA) scores and Annual Examination Science Achievement (AESA) scores of Creative DiscussionApproach (Group A) and Conventional Method (Group B)

School I- Hariyana Vidya Mandir

TMSA	12	74.48	14.68	49.50	10.25	4.833	28	68.85	16.42	51.27	11.77	4.605
AESA	12	66.07	17.40	43.29	8.75	4.052	28	61.18	13.64	42.60	9.85	5.814

School II- Our Lady Queen of the Mission

TMSA	25	73.24	11.20	48.69	10.46	9.082
AESA	25	61.55	15.65	41.95	8.42	6.338

N=Sample Size, M=Mean of Gain Scores, S.D=Standard Deviation.

It was found that t values of teacher made science achievement score between experimental group and control group were significant (P<0.01) with values of 4.833and 8.083 in girls and 4.606 in boys. The corresponding t values of annual examination science achievement scores were 4.052, 5.338 and 5.844 which were also significant at 0.01 level of significance. So the third hypothesis which states that the training in creativity through creative discussion method produces significantly higher achievement in science in experimental group has been accepted.

4. Training and Scholastic Achievement

Total marks obtained by pupils in all subjects in the annual examination of class IX were considered as their scholastic achievement. The score of both the groups were compared. The mean gain, standard deviation and ta value of two groups are given in Table 5.

Table 5:- Post-test Scholastic Achievement Scores (SAS) of Creative DiscussionApproach (Group A) and Conventional Method (Group B)

	Girls						Boys					
		Group A		Group B								
Components	N	M	S.D	M	S.D	t-value	N	M	S.D	M	S.D	t-value
SAS	12	402.40	76.53	312.45	71.85	2.968	28	347.43	68.35	277.40	58.60	4.116
SAS	25	319.95	55.30	232.03	58.87	5.899						

The t values of scholastic achievement scores were 2.969 and 4.898 in girls and 4.116 in boys which were also significant at 0.01 level of significance. Hence, it can be concluded that the training in creativity through creative discussion method obtained significantly higher post-test scholastic achievement scores in experimental group andthe fourth hypothesis is accepted. It is also in concurrence with earlier works.

CHAPTER 5
SUMMARY &CONCLUSION

After processing the data, obtaining and interpreting the results in previous chapter, the findingshave been delimited and discussed in present chapter. These findings can be generalized to the extent of representatives of the sample and methodology employed in the study. In this chapter the results are discussed to show how these findings are concurrent with some of the empirical studies already conducted in the field .At places, some of the observations did not concur with the findings of some

investigators. In such cases, attempts have been made to fathom plausible reasons for these disagreements. Keeping the major findings in view, the educational implications of the study have been worked out. But these findings and implications don not fit in all the concerns of study. As such some suggestions have been given for the further research. The chapter is, therefore devoted to focussing the findings, conclusion, discussion of results of the study and for indicating their implications and suggestions for further studies or research.

SUMMARY

Development of creative thinking ability of students of ninth class by training through creativediscussion approach in bioscience was evaluated. It was observed there was a significant difference in fluency, flexibility, originality and total creativity in experimental group taught through creative discussion method than control group taught through conventional method. The corresponding gain scores were also significantly higher in the experimental group. It was found that training had also significantly influenced the science achievement score and the scholastic achievement score among students.

Objectives

1. To find out the effect of creative discussion approach of teaching bioscience ondevelopment of creative thinking ability of students.
2. To compare difference in gain scores of creativity of subjects between experimentalgroup and the control group.
3. To find out the difference in bioscience achievement scores of subjects of two groups.
4. To determine difference in scholastic achievement scores of two groups.

Hypotheses

H1: There is no significant difference between the effects of creative discussion approach and conventional method of teaching bioscience on development of creative thinking ability of students.

H2:-The Gain scores in total creativity of group taught bioscience through creative discussion approach is significantly higher than that of the control group taught by conventional method.

H3:-The training in creativity through bioscience by creative discussion approach produces significantly higher achievement in science than the conventional method.

H4:-The experimental group obtains higher posttest scholastic achievement scores than the conventional group.

Research Method

In this present study both qualitative and quantitative research design was used to carry out the research work.

Population of the study

The population of the study was limited to a group of male and female school students in Salt Lake, Kolkata.

Sample of the Study

The target population of the study was 120 boys and girls of class IX under the age group of14-16

years from Kolkata, West Bengal. Out of which 65 girls and 55 boys.

Tools and Techniques for data collection.

- **Jalota's Group Test of General mental Ability was used to measure intelligence.**

This intelligence test is group verbal test which has been design by Dr. S.S. Jalota. By this test we can measure the intelligence of a group and classify in intelligent, average and dull categories. The test consist 100 questions with multiple choice and the students should choose one answer among the given options. The test has five separate categories of 20 tasks – vocabulary, classification, number series, analogies and reasoning. The items are mixed. This test was designed in 1951, then revised form published in 1960 and 1963.

MAIN FINDINGS

- The t value between post-test and pre-test fluency scores of two groups were 2.462 and 2.643 in girls and 2.339 in boys which were significant at 0.05 level of significance.
- It indicated that there was significant difference in mean fluency scores of both girls and boys taught through creative discussion approach.
- The t value between post-test and pre-test originality scores of two groups were 2.390, 2.352 and 2.397 in boys which was significant ($P < 0.05$).
- It was found that the t value of gain in fluency score was 5.945 and 6.333 in girls which is significant at 0.01 level of significance and that of boys was 6.656 which is also significant ($P<0.001$).It indicated gain in fluency was significantly higher in experimental group than the control group.
- The t value of gain in flexibility score of two groups were significant ($P<0.01$) in girls (4.229 and 7.877) and boys (10.337). So, it can be inferred that gain in flexibility was significantly higher in experimental group.
- The t value of gain in originality scores of two groups were also significant ($P<0.01$) in girls (5.103 and 5.508) and boys (10.867) indicating significantly higher gain in experimental group.
- The t value of gain in total creativity scores of two groups were found as 8.582 and 9.019 in girls and 12.473 in boys which were significant ($P<0.01$).
- The t values of scholastic achievement scores were 2.969 and 4.898 in girls and 4.116 in boys which were also significant at 0.01 level of significance.
- It can be concluded that the training in creativity through creative discussion method obtained significantly higher post-test scholastic achievement scores in experimental group.

DISCUSSION

According to the present study conducted, a significance of difference in pre-test and post-test correlated mean scores were tested to find out the effect of training on creativity and achievement. A significant difference was observed in mean fluency scores of both girls and boys taught through creative discussion approach. Even a significant difference in mean flexibility score of subjects taught through creative discussion method was observed. A significant difference was also observed in originality score of two groups. Hence the training in creativity had resulted significant difference in creative thinking ability of students taught through creative discussion approach than the control group taught by conventional method. Results of the present work that training creative thinking ability has significant positive effect on creativity of subjects in experimental group is in agreement with earlier works (Khatena, 1973; Jarial,

1981; Singh, 1987.)

CONCLUSION

Development of creative thinking ability of students of ninth class by training through creativediscussion approach in bioscience was evaluated. It was observed there was a significant difference in fluency, flexibility, originality and total creativity in experimental group taught through creative discussion method than control group taught through conventional method. The corresponding gain scores were also significantly higher in the experimental group. It was found that training had also significantly influenced the science achievement score and the scholastic achievement score among students. Hence, recognising its importance there is muchneed to revise our teaching strategy in order to develop creative thinking ability of students inschools and the present work is an attempt in this direction.

IMPLICATION

Some important implications can be derived from the present study.

Teachers should be able to recognise creative thinking as an important aspect and find ways toenhance its development among students. Several research studies has indicated that the idealistic educational approach is more appropriate fir development creativity. Torrance as a pioneer in creativity research pined that too much pressure on children to learn academic subjects bends to prematurely stifle fantasy.

He also set forth five principles which teachers must follow to develop creativity, such as:-

1. To treat children's questions and ideas with respect.
2. To treat unusual ideas with respect
3. To show children their ideas have value.
4. To provide opportunities for self-initiated learning.
5. To provide periods of non-evaluated practice.

There is good scope to develop creative thinking ability of students by adopting suitable teaching strategy based on creative discussion approach. Teachers must be trained in such methods during the in service and pre service training. School Principals need to organize orientation programmes and workshops time to time for their teachers to develop effective oriented teaching skills in teachers by inviting concerned resource persons. Training may be conducted at regular intervals with necessary assessment and feedback programmes. Teachers adopting creative teaching methods should be recognized and honoured by authority.

SUGGESTIONS FOR FURTHER STUDY

1. The present study was conducted in Kolkata, West Bengal only. This may be extendedto other districts and other states in the country.
2. The same study may be undertaken for College teachers and School teachers.
3. The present study confines to a representative sample of school students from Kolkata, West Bengal. Therefore the same study can be conducted for different types of students.
4. Although many different variables are included in the study, there are still some more psychological variables such as personality traits, impulsivity, intelligence, attention, distraction, self-concept, stress, attitude etc. which are not included in the study. Such variables should be considered for further studies.

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