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AN INVESTIGATION INTO THE EFFECT OF A TRAINING PROGRAMME BASED ON EDWARD DE BONO'S COGNITIVE RESEARCH TRUST ON SCIENTIFIC CREATIVITY AND ACHIEVEMENT IN SCIENCE

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Abstract: This article explores the effectiveness of the selected tools namely; Plus, Minus, Interesting (PMI), Consider all factors (CAF) and Consequence and Sequel (C&S) of Cognitive Research Trust Programme (CoRT) 1 on Scientific Creativity and Achievement in science of Class VIII students. A pretest-posttest control group design was employed in the current research. Sample consisted of 87 students in Experimental Group and 90 students in Control Group. Scientific Creativity was assessed using Verbal Test of Scientific Creativity (VTSC) developed by Sharma and Shukla and Academic Achievement in Science was assessed using an Achievement Test in Science developed and standardized by the researcher. The hypotheses were tested using Analysis of Covariance (ANCOVA). The result showed that CoRT was found to be effective in improving students' achievement and scientific creativity.

***Index Terms*:** CoRT Training Programme, Scientific Creativity, Achievement in Science, Effectiveness

I. INTRODUCTION

Science plays a significant role in the progress of any society and all civilization comes to a stan-still, if science is denied a due place from daily life. It is the constitutive feature of modern society, removes the ignorance and illiteracy, questions the dominance of metaphysical beliefs in society and makes an individual intellectually enlightened. Scientific temper and methodology are a part of all kinds of knowledge and studies and science literacy is the need of the hour for the progress. Teaching and learning science become meaningful only when it offers an opportunity to students to unfold their creative and critical skills. How can this be done? This can be achieved through thinking which makes a student to process the information that is already present in him/her.

II. BACKGROUND OF THE STUDY

In post-independent era, India has adopted various methods with an objective of establishing a society based on scientific temperament, humanism and spirit of inquiry. The Indian Constitution in Article 51 A (h) states that it is the fundamental duty of every citizen of the country to inculcate, propagate and disseminates scientific temper in society. Kothari Commission (1964-66) highlights that science and mathematics should be an integral part of general education till the end of the school stage and it should link science with technology in urban areas and with agriculture in rural areas. National Curriculum Framework Policy (2005) recommended that cognitive validity, content validity, process validity, historical validity, environmental validity, and ethical validity should be made part of any science textbook. Education Policy (2020) stresses more on abstract concept and experiential learning during the Middle Stage (Class VI-VIII). The policy focuses on real understanding and learning how to learn and discourages the culture of rote learning and emphasizes on higher order skills of critical thinking, creativity, logical deduction, collaboration, social responsibility, multilingualism, quantitative reasoning, and digital literacy. The curriculum also makes space for more holistic, experiential, discussion-based, and analysis-based learning and provides flexibility in course choices.

By and large it is noticed that textbooks in science project the image of science that is both simplistic and reductionist, ignoring the epistemic, cognitive and social dimensions. Consequently, a vast majority of students have a naive notion and understanding of science. Nakhleh & Mitchell (1993) showed that less than 50% of students were able to answer the parallel conceptual question and did not develop an appropriate understanding of fundamental concepts from the beginning of their studies resulting in poor learning.

National Council of Educational Research and Training (NCERT) conducted a survey (What Students of Class VIII Know and Can Do: A summary of India's National Achievement Survey 2012) on class VIII students in language, mathematics, science and social science and showed that only 44% students were good at simple recall questions and 29% students were able to cope up with questions that required reasoning when it comes to achievement in science. The results indicated a dire need for more research and plan to guide educational improvement. An outcome-based education, appropriate content delivery and exposition of students to the core of science by inculcating in them critical and creative thinking skills are some of the important components to be utilized in science pedagogy to make science education enjoyable, productive and intrinsic to the learning process.

Engaging students actively is the utmost importance in educational process. The overemphasis on evaluation and assessment though with right objectives promote rote learning, blocks creative thinking and affects academic achievement. An appropriate environment, content rich in creative thinking and suitable instructional strategies enhance critical thinking and reasoning ability, boost up achievement and build up scientific temper. There are various means available which are proved to be useful and successful in imparting the science education. Bono's (1973) Cognitive research trust Programme could be implemented in various educational settings for science teaching.

Edward de Bono is considered as the one of the leading authorities in the direct teaching of thinking as a skill. The Programme Cognitive Research Trust (CoRT) is a series of structured exercises devised to teach thinking as a skill. The core of the CoRT thinking method is to direct attention on purpose to different aspects of thinking and to crystallize these aspects into definite concepts and tools that can be used deliberately or even artificially. Bono (1976) holds that the aim of the thinking lessons is very similar to that of coaching in sports: to make the basic operations of thinking second nature so that they are carried out automatically, smoothly, and without any difficulty. This requires defining the operations and practicing them deliberately. Bono (1982) emphasizes that thinking can be taught on the basis that thinking simplifies things and attitudes, and it is a simple process. The CoRT program focuses on a special concept for thinking and perception, and the relationship between them. Bono compares the learning of thinking skills to ride a bike or swimming. Initially the learner feels confused and considers learning them is difficult and unnecessary. However, after acquiring certain degree of skill, talking about the existence of confusion is absolutely illogical. The CoRT programme is divided into six parts, each of which contains ten lessons. Each part has a name which indicates a purpose that should be achieved while completing it. They are described briefly as follows:

- CoRT (1) is breadth which broadens the understanding of students. It is the fundamental basis for future lessons, because it provides necessary skills.
- CoRT (2) is organization which helps students to organize their thoughts, to identify the problems and to develop strategies for solutions.
- CoRT (3) is interaction which is concerned with developing the process of discussion and negotiation among students, so that students can assess and control their knowledge.
- CoRT (4) deals with creativity and considers creativity as a natural part of the process of thinking; thus, it can be taught to students.
- CoRT (5) basically deals with information. In this part, students learn how to collect and provide information effectively, as they learn how to recognize the ways that make their feelings and values significant to the building of the information operations.
- CoRT (6) is action which is interested in the process of thinking as a whole starting from choosing the goal and ending with the formation of the plan to implement the solution.

There is a tendency to have a narrow approach in daily life by taking up an instant judgment position on an issue without examining all the factors involved before one makes a final decision. Each of the lessons in CoRT 1 is designed in such way that they encourage students to broaden their thinking and define attention areas into which thinking can be directed. In the current study, the researcher looked into the effect of selected tools namely; PMI, CAF and C&S of CoRT 1 programme on Scientific Creativity and Achievement in Science (De Bono E., 1993 & de Bono's Thinking Lessons, n.d.).

- **Plus, Minus, Interesting (PMI):** It is a tool for directing attention. Positive points are prioritized, followed by negative points, and finally by fascinating points. When there is a lot of indecision or a prejudged reaction to a circumstance, the tool is used.
- **Consider All Factors (CAF)**: This mental function is mostly associated with action, decision, planning, judgement, and reaching a conclusion. The tool is used for planning, designing a system, or deciding on a vocation.
- **Consequences and Sequel (C&S):** This is the crystallization of the process of anticipating the outcomes of some action, plan, decision, rule, or invention. It corresponds to the overall expansion of perception.

III. RATIONALE OF THE STUDY

Fostering thinking as a skill has always been the primary goal of formal education, as well as a fundamental goal of teaching and learning in all fields. In today's fast changing environment, teaching thinking is more important than providing facts. Knowledge quickly becomes out of date, and in any event, the ability to use the information is required. As a result, there is a need to openly and actively teach constructive thinking skills. Currently, the lecture approach is utilized in classrooms, which neither grabs students' full attention nor has the ability to develop higher mental qualities such as thinking, reasoning, and problem solving, which are the most significant in life. As a result, there is an urgent need to create exercises that instructors may employ in the classroom to foster creativity, reasoning, and critical thinking skills. Researchers have attempted to foster creativity through the use of various tactics such as brain storming, morphological synthesis, metaphors and analogies, and so on. Aside from these, Edward de Bono presented another technique, CoRT (Cognitive Research Trust Programme), which has the potential to improve thinking skills. Through the use of his programme CoRT, Edward de Bono says that thinking can be taught, and if we can teach our pupils how to think? We can assist them in reaching their full potential.

A few studies have been conducted in India using the Co RT programme, and the researchers discovered it to be helpful in encouraging creativity and thinking, but the number of researchers is insufficient to give a solid empirical data. It is not possible to generalize from the available research because the number is tiny and just a few investigations are conducted in India. As a result, further research is needed to understand its usefulness and make it a necessary element of school curricula. The purpose of this study is to look into the effectiveness of the CoRT programme as a novel instructional method for developing creative thinking and achievement. As a result, the investigator has chosen the current study.

IV. OBJECTIVES OF THE STUDY

1. To compare mean scores of Scientific Creativity of Class VIII students treated through CoRT Programme and Lecture Method.
2. To compare mean scores of Achievement in Science of Class VIII students treated through CoRT Programme and Lecture Method.
3. To study the effect of Treatment, Gender and their interaction on Scientific Creativity of Class VIII students.
4. To study the effect of Treatment, Gender and their interaction on Achievement in Science of Class VIII students.
5. To study the effect of Treatment, Community and their interaction on Scientific Creativity of Class VIII students.
6. To study the effect of Treatment, Community and their interaction on Achievement in Science of Class VIII students.

V. HYPOTHESES OF THE STUDY

1. There is no significant difference in mean scores of Scientific Creativity of Class VIII students treated through CoRT Programme and Lecture Method.
2. There is no significant difference in mean scores of Achievement in Science of Class VIII students treated through CoRT Programme and Lecture Method.
3. There is no significant effect of Treatment, Gender and their interaction on Scientific Creativity of Class VIII students.
4. There is no significant effect of Treatment, Gender and their interaction on Achievement in Science of Class VIII students
5. There is no significant effect of Treatment, Community and their interaction on Scientific Creativity of Class VIII students.
6. There is no significant effect of Treatment, Community and their interaction on Achievement in Science of Class VIII students.

VI. RESEARCH METHODOLOY

Research Design: Since the current investigation was intended to study the effect of the Cognitive Research Trust Programme on creativity and achievement in science, a pretest-posttest control group design was employed.

Population and Sample: All class VIII students of Don Bosco Schools of West Bengal and Sikkim constituted the population of the study. After choosing two schools, using simple random techniques, the students of class VIII were allotted to experimental group and control group. The experimental and control groups had 87 and 90 students respectively.

Tools Used: Scientific Creativity of students was assessed using Verbal Test of Scientific Creativity (VTSC) developed by Sharma and Shukla. Academic Achievement in Science was assessed using an Achievement Test in Science developed and standardized by the researcher. The researcher also developed traditional lesson plan based on 2 units each on physics, chemistry and biology to teach the control group. The experimental group was taught the same chapters with the help of lesson transcripts developed based on CoRT strategy.

Collection and Analysis of the Data: The students of experimental and control groups were pretested with the help of Scientific Creativity Test and Achievement Test in Science. The Experimental Group underwent CoRT training programme at the rate of one period per day for two months and at the same time the students of Control Group were taught the same topics through Lecture Method at the rate of one period per day for two months. At the end of the Treatment both groups were post-tested with the help of same tools as used at Pre-test stage and the results were collected and tabulated using SPSS version 22. The hypotheses were tested using analysis of covariance (ANCOVA).

VII. MAJOR FINDINGS

1) Scientific Creativity of students treated through CoRT programme was found to be significantly more effective in comparison to Lecture Method when their Pre-Scientific Creativity was considered as covariate. The adjusted mean scores of Scientific Creativity of students treated through CoRT Programme is 323.11 which is significantly higher than those taught through Lecture Method whose adjusted mean score of Scientific Creativity is 227.07 when their Pre-Scientific Creativity was considered as covariate.
2) Achievement in Science of students treated through CoRT programme was found to be significantly superior to Lecture Method when their Pre-achievement in Science was considered as covariate. The adjusted mean scores of Achievement is Science of students treated through CoRT Programme is 29.18 which is significantly higher than those of Lecture method whose adjusted mean score of Achievement is 22.
3) Scientific Creativity of students was found to be independent of interaction between Treatment and Gender when their Pre-Scientific creativity was considered as covariate.
4) Achievement in Science of students was found to be independent of interaction between Treatment and Gender when their Pre-Achievement in Science was considered as covariate.
5) Scientific Creativity of students was found to be independent of interaction between Treatment and Community when their Pre-Scientific creativity was considered as Covariate.

6) Achievement in Science of students was found to be independent of interaction between Treatment and Community when their Pre-Achievement in Science was considered as Covariate.

DELIMITATIONS OF THE STUDY

- Only class VIII students of Don Bosco Schools of West Bengal and Sikkim are considered for current study.
- This experimental study is carried out in two selected schools
- Treatment was carried out only for two months.
- Only few selected tools of CoRT 1 are used in developing the instructional strategy. The selected tools are: Plus, Minus, Interesting (PMI), Consider All Factors (CAF) and Consequence & Sequel (C&S).
- Syllabus chosen is based on ICSE curriculum given by Indian Council for Secondary Education, New Delhi.

CONCLUSION

CoRT was found to be effective in improving students' achievement and scientific creativity. The application and integration of appropriate and constructive pedagogical strategies fosters a culture of higher order thinking in all science task engagements, removes barriers such as prejudices, conjectures, mental blocks that may impede effective processing of information and knowledge production and enhances creative learning leading to newer ways of perceiving and interpreting their experiences. CoRT strategies, as demonstrated by the current study, can undoubtedly produce perpetual novel thinkers capable of synthesizing their experiences, integrating information and feedback, exposing underlying causes for a phenomenon, adding a new meaning to existing concepts, or discovering something entirely new.

CoRT promotes scientific imagination, creative problem solving, problem solving in science and technology studies, inquiry and innovation, an open inquiry, creative writing, metaphor and analogies to understand phenomena and idea, mystery solving, and makes learning and teaching science more enjoyable. It challenges schoolchildren to search for link between seemingly discrete idea and facts, and provides opportunities for aesthetic experiences. Student-centered learning, coupled with the effective use of CoRT, promotes creative thinking and innovation in students. The main roadblock is teachers' willingness to change in order to meet a country's development goals. Students' lack of interest in science is a persistent issue, but integrating creative training programmes into science instruction in schools helps broaden horizons for both instructors and students and in turn, this bolsters better academic performance in science.

One must recognize that learning science, or any subject for that matter, is not merely a solitary and internal activity, but rather an integrated whole in which a wide spectrum of learning efforts is diversified and directed toward the active engagement of a learner. This would call for frequent opportunities and a positive attitude toward the subject, allowing a learner to logically and sensibly connect the knowledge they have assimilated and to think, act, and apply science expertise to real-life situations. Effective methodology application instils in students a sense of confidence in their ability to comprehend various science concepts, theories, phenomena, and processes, which makes them proficient and their knowledge stronger, durable, adaptable, useful, and relevant. The findings of the study will undoubtedly have far-reaching implications for those involved in educational management and administration. Therefore, it is imperative that curriculum designers, policymakers, and teacher educators should dedicate a considerable amount of time and educational resources with an objective of making the necessary critical interventions in in-service and pre-service teachers training.

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