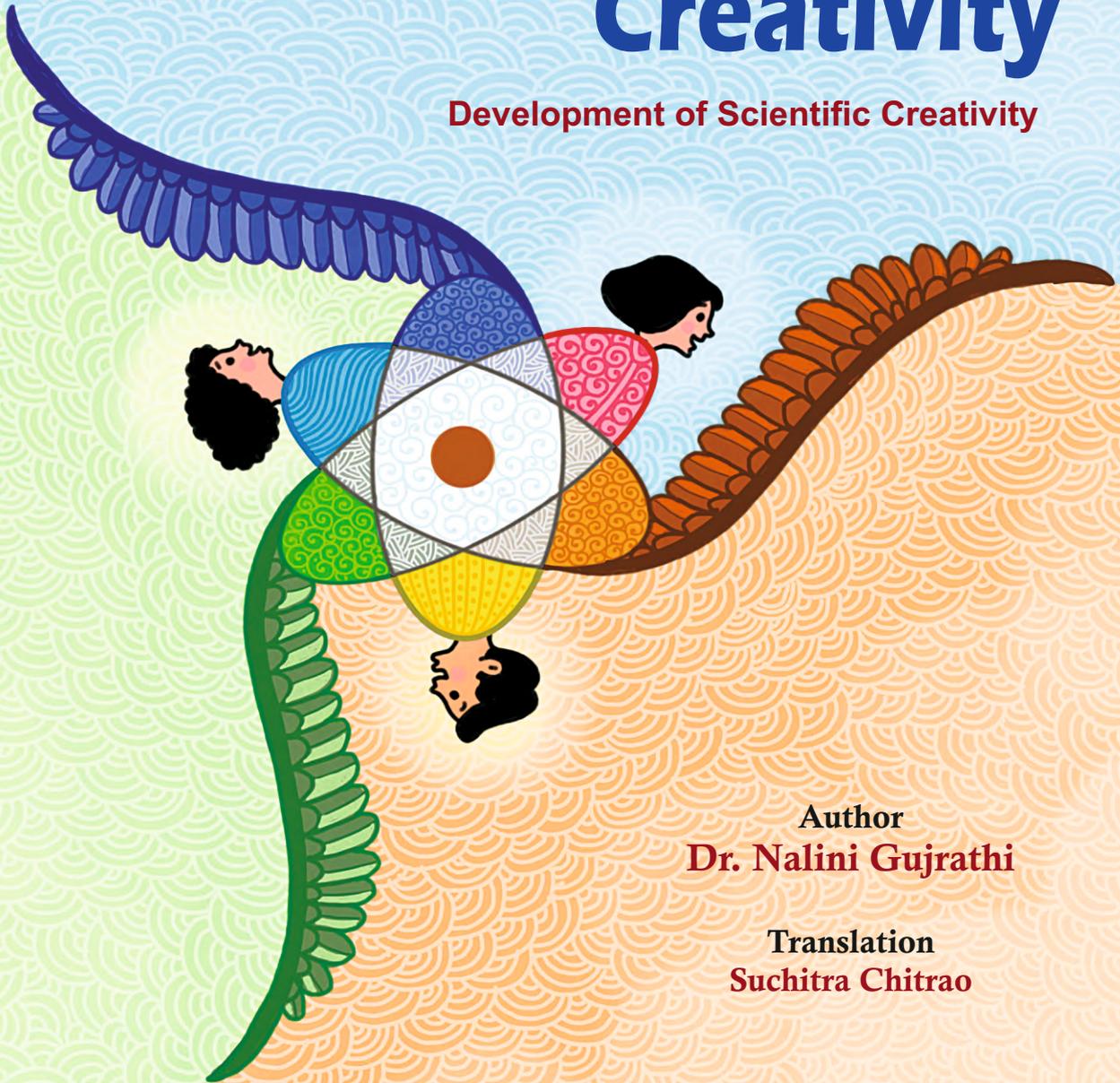


Let's Unfold the Wings of Creativity

Development of Scientific Creativity

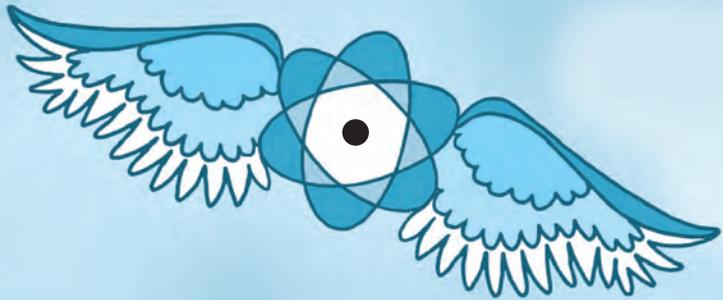


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Let's Unfold the Wings of Creativity

(Development of Scientific Creativity)



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Preamble

It gives me great pleasure to offer the book *Let's Unfold the Wings of Creativity* to my readers. This book is primarily designed for the higher secondary students (class 8 to 12), their parents and their teachers. But still, I am sure that it can guide all those who wish to know about the techniques of scientific creativity.

Creativity is popularly identified as the expression of innovative ideas which sprout in the imaginative minds of literary scholars and artists. Creative expression always blooms with ingenious ideas. Such expressions are seen in all the fields; be it literature, art or science. Some of the aspects of creativity in science (Scientific creativity) are new inventions, novel products, improving the existing objects and finding solutions to problems. Creativity is necessary in every field. Right from modern technology and inventions in science that have made a valuable contribution to our day-to-day life and to the fields like agriculture, industry, business, information technology and national defence. The inventions like mobile smart phones, artificial intelligence, drones, digitalisation, virtual labs and online education are simply marvellous, as if a magic wand of scientific creativity is at work. In such a scenario, the necessity of teaching creativity skills to the students right from a young age is indisputable.

I would like to share with my readers, the background and the motivation behind this book. In the year 1969, Dr. V. V. alias Appa Pendse, founded the institute named 'Jnana Prabodhini Prashala', a school for all-round development of the gifted and intelligent students. His aim was to train them to be responsible

leaders, capable of addressing the various national issues across different fields. As a major step towards this goal, their department of Psychology, named 'Prajna Manas Sanshodhika' took up active research in the field of measurement and development of Intelligence and Creativity.

Dr. Usha tai Khire, the head of Prajna manas Sanshodhika, had just completed her research about the mutual relationship between intelligence and creativity that time. She had also designed some I.Q. tests.

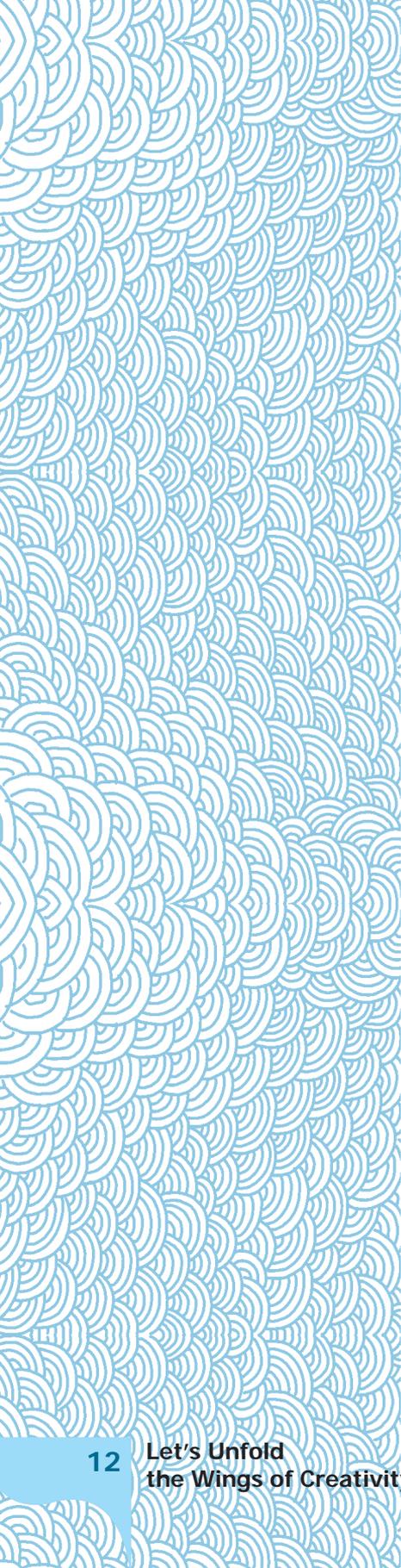
Another noted scholar from the same department, Dr. Ashok Nirpharake, had designed a training programme based on his research about the development of creativity and it was partly implemented at Jnana Prabodhini Prashala. Dr. Pendse was of the opinion that the research for a Ph.D. degree must be applicable to teaching and also in day-to-day life. So, some school periods were devoted to the development of creativity of the students, based on Dr. Nirpharake's research. It was because of these teaching periods that I came in close contact with the concept of creativity. The importance of creativity started dawning upon me and made me all the more curious about the subject. I got an opportunity to teach under Dr. Pendse's guidance as well as run the girls' section of Jnana Prabodhini Prashala as the principal from 1973 to 1985. I had received a master's degree in Chemistry as well as a master's degree in education. I was teaching Chemistry and Physics in the school.

In the year 1975, I organised a science project camp for the students. The students were asked to do research projects in science. Then onwards, the project camps became an annual feature. The camps made me think extensively about scientific creativity. I started wondering about the exact difference between the creativity in linguistics/ art forms and the scientific creativity, and whether creative abilities in science could be measured and developed. In the years 1987 – 1992, I achieved a Ph.D. degree based on research in 'Developing Scientific Creativity'. Guilford model, proposes 29 different abilities of scientific creativity. Out of them I short listed 6 significant abilities which are applied in the field of science and technology.

They were:

- 1) Finding Unusual Uses.
- 2) Inquisitiveness (asking questions).
- 3) Seeing a Problem.
- 4) Making Improvements.
- 5) Guessing Causes.
- 6) Guessing Consequences

I formulated and standardised a test to measure these six abilities of the students in class 9. The measurements were based on three abilities: Fluency, flexibility and originality. I also studied various psychological techniques and applied them to develop a two-month long training programme for creativity development, of two hours



per day. I trained the students using the experimental – control group pre-test, post-test design. Then with the help of many statistical tests, I proved that training can enhance scientific creativity. For the pre-test and post-test, I used the tests of scientific creativity which I myself had designed (as a part of my research), along with some other scientific creativity tests. 1992 onwards, I conducted some teachers’ training workshops in different schools, colleges, architecture colleges, Academic staff college in Poona university as well as the employees of various industries and business houses. Every time, the response was positive, and yet the participants rarely applied the techniques of creativity in their fields, the reason being the lack of awareness about creativity and its significance in our country. There was neither any scope nor encouragement for applying creativity in day-to-day life or teaching it in the curriculum.

Till date, teaching is a text book centred activity. Study skills are totally ignored. For instance, the listening skills, comprehensive reading skills, memory skills, writing skills, skills of note-taking, making study plans and other skills necessary for self-study, are not taught at all. Learning the use of the creativity skills for generating innovative ideas sounds a far-away thing in the scenario where students do not even possess the skills for listening with concentration, reflecting upon the topics, improving the reading speed, note-taking, writing in the appropriate style and to the point. While striving to develop the creativity skills, I went through a depressing time due to these reasons. My comfort zone was Jnana Prabodhini Prashala. There, equal emphasis was given on the text books and the study skills. In fact, the study skills and development of intelligence and creativity got a slightly greater importance.

In the year 2019, the Central government announced the New Education Policy (NEP) and there has been a quantum jump in the education reforms. The aim of education is not restricted to the subject knowledge anymore. At school level, much emphasis is to be given on teaching the skills of evidence based scientific thinking,

scientific temper, logical deduction, quantitative reasoning, creativity and innovation. The NEP inspired me to write a book and thus the book was completed.

The central theme of this book is the training in creative thinking skills and development of creativity using various techniques. The ideas for any new production are initially formed in the mind. Ideas do appear spontaneously but more ideas can be generated by applying the techniques of creativity development. Through lot of research, it has been proved beyond doubt, that creativity can be enhanced by training. As mentioned earlier, the topic of my research was related to this very topic. All the chapters in this book are woven around a single enchanting word, 'idea! idea!! and idea!!!' I am sure, you will notice that every page reflects the obsession about enhancing the students' creativity and allied thinking skills.

On realising the fact that in the modern times, we cannot afford to neglect the objective of initiating and developing the creativity of the students; the government has started various creativity related programmes in schools and colleges in the past decade. Scientific projects to find ways to solve certain issues have been undertaken in many schools, in the Atal tinkering labs. National level project competitions are being held. In addition to this, there are similar competitions arranged by Nasa, Ignite and Intel.

This book is beneficial for the participants of these competitions. The major advantage of this book is that it offers simple methods of learning the techniques of creativity, like generating new ideas and problem solving. The applications of these techniques are discussed separately, as well as in the respective chapters, whenever required.

Such activities are enthusiastically conducted at the centres of Jnana Prabodhini which are located in Pune, Nigadi, Solapur and Harali. At the centre in Pune, there is a lab named 'Dhadpad prayog shala' (धडपड प्रयोगशाळा) (meaning: Pro-active lab). The students who are interested in trying out experiments and projects are welcome to avail the facilities at this lab. At the Atal tinkering lab of the Nigadi centre, many research projects have won awards. From one of such projects they have started small scale production of Au-Spray, an antibacterial spray. The fact that these opportunities are now reaching the students in the rural area of Harali and salumbre; makes me happy. Information about few selected creative projects is given in Appendix 3.

The concept of creativity is quite extensive. It includes various facets like the creative process, the creative product, creative personality and suitable environment for creativity. Apart from these, the study of creativity also includes creative abilities, their measurement and development. In the appendix, I have written an article highlighting these points. Interested readers are welcome to go through it. The list of reference books is also given in appendix 2 for the curious readers.

I have written the book in a conversational style with a purpose. Writing articles and giving lectures to teach creativity skills was way too insufficient, in my opinion.

The book, 'Let's unfold the wings of creativity' is a lucid account of Dr. Nalini Gujrathi's research about the development of scientific creativity. The dialogue form has made the book very effective and appealing to the teenagers and the grown-ups alike. Applications of various psychological techniques to develop creative thinking are revealed here. Techniques like brainstorming, 11 processes of transformations, attribute listing, synectics and creative problem solving are explained with simple examples of common objects like a chalk-stick, an umbrella, a chair etc. The methods of applying these techniques in the field of science have also been demonstrated. Methods to develop the observation skills and questioning skills, which are fundamental to these techniques are clarified at the beginning.

Any new creation is impossible without the generation of ideas in the mind. All the chapters in the book are woven around a single theme, 'generating a large number of innovative and varied ideas. Each page highlights the term 'ideas, ideas and ideas!' In the New Education Policy, emphasises the development of creative thinking and therefore this book will be useful to the students, teachers and parents, to shape the new generation.

“We have to remould the school science education to the mode of 'learning by discovery' and 'learning by doing' in contrast to the prevailing 'learning by rote' method...

... Our students must not only love science but they must live science.”

Let me confess honestly, that I only mentioned what needs to be done but did not say how it is to be done. Ways of developing the scientific creativity are very effectively explained in Nalini tai's book.

I have been working in the field of science research and leading laboratories for the past six decades. Yet, after reading this book by Dr. Nalini Gujrathi, I felt that if I had read it in my school days, I would have been a still better research scholar.

Dr. Raghunath Mashelkar

(From the foreword of the book...)

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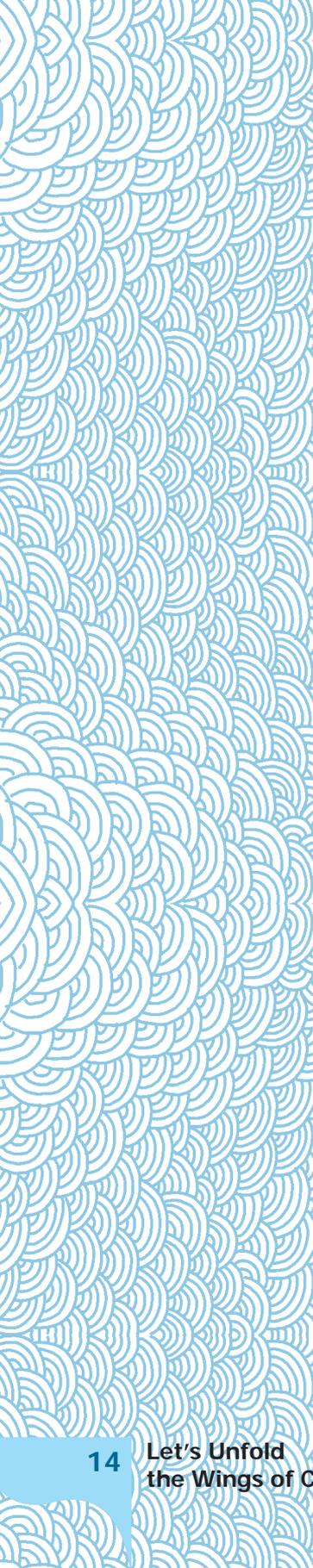
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Motivating the students' thought processes as well as stimulating their imagination and giving some scope for its expression was very important. Reading the conversations will not only help the students to understand the topics but will also encourage them to ask questions, generate new ideas and be frank enough to share their ideas with others. The general outline of the discussed topics is given at the end of each chapter. This will facilitate the ease of remembering the gist. The book contains lots of exercises which will be beneficial if the parents and the teachers ensure that the students solve them. QR codes are given in the book to view the novel videos showing scientific creativity. Readers should try to identify the techniques/processes from the book in these videos.

The names of the characters in the conversations are thoughtfully chosen. In many Indian languages, the words Prerana, Kalpana, Naveen and Srujan indicate the qualities related to creativity (Inspiration, Idea, Novel and Innovative). The teacher's name is Pratibha which means creativity. The four students are very enthusiastic, proactive and inquisitive. In some sense they represent the ideal students. But that does not at all mean that the skills of creativity development are meant only for the gifted and the talented children. Creativity is present in every individual, only the proportion varies from person to person. Therefore, the average students too should learn these skills to achieve a fulfilling career and to enrich their lives.

If we wish to mould business people, industrialists, scientists and technocrats, for the worldly progress of our country, we have no choice but to 'catch them young'. Therefore, teaching the techniques and skills of creativity development is of fundamental importance. I am sure that this book will be useful to achieve this goal to a great extent.

This English translation of my original Marathi book is done by Mrs. Suchitra Chitrao, my student from Jnana Prabodhini Prashala.

I wish to get this book translated in Hindi and other Indian languages too so that it reaches a large number of students, teachers and parents. If I am able to render a small service to our nation by motivating students and stimulating their creativity, it will be the appropriate homage to esteemed Dr. Pendse.

- Dr. Nalini Gujrathi.

Index



- ◆ **Foreword** 6
- ◆ **Preamble** 10
- ◆ **Acknowledgement** 15
- ◆ **Author Introduction** 16
- 1. Introduction to Scientific Creativity** 17-25
- 2. Observation Skills** 26-47
 - 2.1 Criteria for Good Observations 26
 - 2.2 Observation Check-List: Group-1 31
 - 2.3 Observation Check-List: Group-2 39
- 3. Questioning Skills** 48-69
 - 3.1 Game of 20 Questions 48
 - 3.2 Question Storming and Criteria for Good Questions 56
 - 3.3 Applications of Question Check-List 62
- 4. Brain Storming** 70-88
 - 4.1 Nature and the First Principle 70
 - 4.2 The Second Principle and Applications 76
- 5. Attribute Listing** 89-100
 - 5.1 Five Principles 89
 - 5.2 Modifications in Attributes 96
- 6. Transformations - Divergent Production** 101-120
 - 6.1 Magnification, Minification, Addition, Omission 101
 - 6.2 Modification, Substitution, Combination, Rearrangement 108





6.3 Reversal, Adaptation, Other Uses 114

7. Morphological Analysis 121-126

8. Synectics 127-136

8.1 Forced Relationships
and Synectics 127

8.2 Analogy 132

9. Science Fiction 137-140

10. Sensitivity to Problems 141-146

11. Creative Problem Solving 147-160

11.1 Finding Mess, Data, Problems and Ideas 147

11.2 Finding Solutions, Acceptance 152

12. Applications of Scientific Creativity 161-172

12.1 Open Ended Experiments, Research
Projects, Production 161

12.2 Makeover (Development) of the Nation 167

Appendix 173-192

♦ **Appendix 1 - Creativity – Concept, Measurement and Development.** 174

♦ **Appendix 2 - Selected Bibliography: Techniques of Creativity Development.** 184

♦ **Appendix 3 - Projects by Jnana Prabodhini Students Showing Scientific Creativity.** 185

QR Code for the Video Clips of Innovative

Expressions of Scientific Creativity 87, 88, 120, 159

Jnana Prabodhini Publications - 192



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