

## **DECLARATION**

I, Chandrang Pathak, hereby declare that the Thesis titled **‘Situating Constructivist Strategies in Lecture: An Exploration in Pedagogy of Science at Secondary Level’** is my own work and was carried out during the years 2021-2025. It has not been previously submitted for the award of any degree. I have acknowledged all assistance received in the preparation of the thesis.

This thesis has been completed under the supervision of my esteemed Guide, Prof. R. C. Patel, Former Head and Dean of the Department of Education, Faculty of Education and Psychology, The Maharaja Sayajirao University of Baroda, Vadodara.

Mr. Chandrang Pathak  
Researcher  
Department of Education  
Faculty of Education and Psychology  
The Maharaja Sayajirao University of Baroda, Vadodara  
May 2025  
Place: Vadodara



**Department of Education**  
Faculty of Education and Psychology  
The Maharaja Sayajirao University of Baroda, Vadodara

## **CERTIFICATE**

This is to certify that the work contained in this thesis entitled “**Situating Constructivist Strategies in Lecture: An Exploration in Pedagogy of Science at Secondary Level**” which is being submitted by Mr. Chandrang Pathak to The Maharaja Sayajirao University of Baroda, Vadodara, for the degree of Doctor of Philosophy (Ph.D.) in Education is a record of bonafide original research work conducted by her under my supervision and guidance. The results embodied in the same have not been submitted elsewhere for any degree or diploma award. It is further to state that the doctoral research fulfilled the requisite attendance criteria as per O. Ph.D. 4 (iii) of The Maharaja Sayajirao University of Baroda, Vadodara. I find the work fit for submission and evaluation.

May, 2025  
Vadodara

**Prof. R. C. Patel**  
Guide  
Department of Education  
The Maharaja Sayajirao University of Baroda  
Vadodara 390002

## ACKNOWLEDGEMENT

First of all, I am thankful to Almighty God. His blessings and grace provided me with the willpower and fortitude to begin and finish my doctoral journey.

I owe a debt of gratitude to my mentor, Professor R. C. Patel, who not only provided me with unwavering patience and acted as a torchbearer throughout my study but also allowed me to learn under his direction. In addition to his extensive knowledge, he is a compassionate individual, and I value his support during the challenging moments of my journey. Whenever I needed him, he always supported me personally and professionally without my asking.

I am thankful to Dr. Ajeet Kumar Rai, Associate Professor at Banaras Hindu University, who gave me this research idea and provided assistance whenever I needed.

After that, I am expressing my gratitude to my parents, Jaya Pathak and Manoj Kumar Pathak, who gave me this opportunity to complete my Ph.D. work without any problem.

I am deeply grateful for the invaluable help provided by Prof. Ashutosh Biswal, Head of the Department of Education and Dean of the Faculty of Education and Psychology.

I am very thankful to express my gratitude to Prof. S. C. Panigrahi, who provided time-to-time support and guidance during my study. I also express my gratitude to Dr. Bhavin Chauhan, who provided support during my documentation during my Ph.D. journey in this continuum, and to Prof. Satish Pathak and Prof. Sujata Shrivastava, Avani Sharma, Principal, University Experimental School, and Bhagesh Thakkar, Principal, Vidyut Board Vidyalaya, for their constant support.

I express sincere gratitude to Shambhu Nath Upadhyay and Vedanti Shah, who helped me during my data collection. I am extremely thankful to Ekta Priyadarshini, who helped me with the proofreading of my entire thesis. I also express gratitude to Dr. Naveen M. who provided me assistance during my paper publication and lesson planning and to Dr. Shefali Dimmer for her assistance during the documentation in this continuum I present my gratitude to all experts who gave me valuable and immediate suggestions during my validation of the lesson plans and tools for data collection.

I want to give thanks to Dr. Preeti Saxena, Laxmi Meher, Boski Singh, Birina, Vaishnavi, Sarita, Agradeep, Satyajit, Dipesh, Sushma and other researchers who helped me directly and indirectly during my Ph.D. work.

I am thankful to the whole family of my guide who are always loving and caring for me, because of them I never felt that I am staying outside of my home and have given support whenever I needed.

I am extremely thankful to my wife, Shalini and my brother Devansh and my neighbor Neeraj Tiwari and his family, who gave me moral support throughout my Ph.D. work.

Last but not least, I am thankful to the Government of Gujarat and the University Grants Commission for providing me fellowship, which enabled me to do my Ph.D. work without any financial stress.

Chandrang Pathak  
Research Scholar  
Department of Education  
The Maharaja Sayajirao University of Baroda  
Vadodara

## LIST OF TABLES

Sr. No.	Content	Page No.
Table 3.1	Phases of Development of the Intervention Programme	101
Table 3.2	Synoptic View of the Topic Taken for Intervention Programme Development	101
Table 3.3	A Brief Description of Topics with Their Subtopics and Activities in the Intervention Programme	103
Table 3.4	Constructivist Strategies Selected for the Intervention Programme	123
Table 3.5	Design of the Study	126
Table 3.6	Variables of the Study	126
Table 3.7	Number of Participants	127
Table 3.8	Types of Ravens Progressive Matrices	127
Table 3.9	Blueprint of the Achievement Test	131
Table 3.10	Number of Items Based on Cognitive Domain	133
Table 4.1	Tests of Normality	136
Table 4.2	Value of Skewness and Kurtosis	138
Table 4.3	Descriptive Properties of Academic Achievement Score	139
Table 4.4	Descriptive Properties of Cognitive Load	141
Table 4.5	Mann-Whitney U Test on Achievement	142
Table 4.6	Mann-Whitney U Test on Cognitive Load	143
Table 4.7	Students' Reaction Towards Constructivist Pedagogical Intervention	147
Table 5.1	Design of the Study	196
Table 5.2	Variables of the Study	196
Table 5.3	Number of Participants	197

## LIST OF FIGURES

Sr. No.	Content	Page No.
Figure 1.1	Nature of Science (cyclic nature of Process and Product)	12
Figure 1.2	Nature of Science	13
Figure 1.3	Atkinson-Shiffrin Multi-Store Model of Memory	33
Figure 1.4	Model of Working Memory	34
Figure 2.1	Published Document in SCOPUS Database (Year-wise)	88
Figure 2.2	Emerging Field of Study (SCOPUS Database)	90
Figure 2.3	Published Document in SCOPUS Database (Country-Wise)	90
Figure 3.1	Steps of the Study	134
Figure 4.1	Distribution of Cognitive Load Scores	137
Figure 4.2	Distribution of Achievement Scores	138
Figure 4.3	Academic Achievement Scores	140
Figure 4.4	Cognitive Load Scores	142
Figure 4.5	Relationship Between Cognitive Load Scores and Achievement Scores	145
Figure 4.6	Intensity of Reactions of Students on Developed Constructivist Pedagogy	154
Figure 5.1	Nature of Science (cyclic nature of Process and Product)	166
Figure 5.2	Nature of Science	167
Figure 5.3	Atkinson-Shiffrin Multi-Store Model of Memory	184
Figure 5.4	Model of Working Memory	185
Figure 5.5	Steps of the Study	199

## LIST OF APPENDICES

<b>Sr. No.</b>	<b>Content</b>
<i>Appendix: 1</i>	List of Experts
<i>Appendix: 2</i>	Science Achievement Test
<i>Appendix: 3</i>	Cognitive Load Scale
<i>Appendix: 4</i>	Reaction Scale
<i>Appendix: 5</i>	Constructivist Intervention Programme
<i>Appendix: 6</i>	Raven's Progressive Matrices (Intelligence Test)
<i>Appendix: 7</i>	First Draft of Science Achievement Test
<i>Appendix: 8</i>	Permission Letter from School (Experimental Group)
<i>Appendix: 9</i>	Permission Letter from School (Control Group)
<i>Appendix: 10</i>	Data Collection Completion Certificate
<i>Appendix: 11</i>	Coursework Certificate
<i>Appendix: 12</i>	Paper Presentation Certificate
<i>Appendix: 13</i>	Published Paper
<i>Appendix: 14</i>	Suggestions from Experts