



Case Report

Science Museums as Engines of Cultural and Tourism Development: A Case Study with the Visitors Figure Analysis of Nehru Science Centre, Mumbai, India

Tapas Kumar Moharana^{1,*} , Anindita Mondal²

¹Exhibit Development Division, Nehru Science Centre, Mumbai, India

²Education Division, Nehru Science Centre, Mumbai, India

Abstract

This paper examines the transformative role of the Nehru Science Centre, Mumbai (NSCM), as a driver of tourism, education, and cultural enrichment. By analyzing visitor statistics and programmatic innovations from 2017 to 2024, the study positions NSCM as a model for museum-driven development within the global context. Strategic collaborations with travel agencies have enhanced NSCM's visibility, positioning it as a prominent destination for cultural and educational tourism. These partnerships have effectively bridged the gap between leisure travel and experiential learning, attracting diverse visitor demographics. NSCM has successfully integrated its exhibits and programs into educational frameworks, fostering a culture of curiosity and scientific literacy among students. Its adoption of hybrid learning models and experiential pedagogy has enriched formal education while inspiring youth engagement with science. The centre has played a pivotal role in embedding a culture of tourism in society by emphasizing the value of museums as spaces for public learning and engagement. During the COVID-19 pandemic, NSC adapted swiftly with virtual programs, demonstrating resilience and reinforcing the societal importance of museums. Through quantitative analysis and predictive modeling, this study highlights NSCM's contribution to Mumbai's tourism ecosystem and its broader implications for cultural development. The findings underscore how science museums can catalyze tourism growth while fostering education and community engagement, setting a benchmark for similar institutions worldwide.

Keywords

Nehru Science Centre, Travel Agency Collaboration, Museum Education, Tourism Culture, Public Engagement, Visitor Analysis

1. Introduction

National Council of Science Museums (NCSM) stands as a pioneering institution in India, dedicated to the widespread popularization of science and technology across the nation. The annual reports of NCSM underscore its commitment to communicating

scientific ideas to the public through interactive exhibitions, digital outreach, and initiatives promoting innovation and research, such as Innovation Hubs and collaborations with research institutions. Nehru Science Centre (NSCM) in Mumbai, a prominent

*Correspondence: Tapas Kumar Moharana (mechengineer.tapas@gmail.com)

Received: 2 July 2026; Accepted: 15 July 2026; Published: 10 August 2026



Copyright: © The Author(s), 2026. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

constituent unit of NSCM, has been at the forefront of this mission, organizing a wide array of programs and exhibitions, including Science on a Sphere, Mobile Science Exhibitions, and Teacher Training Programs. The substantial increase in visitors to NSCM's science museums and centres, from 6,41,423 in 2022-2023 to 7,03,509 in 2023-2024, highlights a growing public interest in science and technology and the effectiveness of NSCM's initiatives in making science accessible and engaging for all [3, 11, 12].

Since 2022, NSCM has consistently attracted over 700,000 visitors annually, providing them with opportunities to experience the fundamental principles and marvels of science and technology. In an era where museums are increasingly recognized for their multifaceted roles in society, NSCM has emerged as a significant contributor to both cultural enrichment and tourism development. The research presented here stems from the increasing recognition of museums as key players in the tourism sector, offering unique educational and cultural experiences that attract visitors, stimulate local economies, and promote cultural exchange.

This paper seeks to address the following research questions:

- 1) What role has NSCM played in integrating museum-based learning into educational curricula?
- 2) How has NSCM contributed to society enhancing public engagement with science?
- 3) How did the NSCM adapt to the challenges during the COVID-19 pandemic, and what does this show about the resilience of such institutions?
- 4) How has NSCM's collaboration with travel agencies influenced its visitor numbers and tourism impact?

To answer these questions, this paper will primarily analyze visitor data from 2017 to 2024, including total visitor numbers and program participation rates, and provide an overall historical context from 1977 to 2024, examining trends and patterns that reflect NSCM's impact on educational engagement and influence of tourism. Additionally, it will explore the centre's programmatic innovations, including its integration of hybrid learning models and experiential pedagogy. The structure of this paper will proceed with a review of existing literature, followed by methodology, findings, discussion, and finally, conclusion.

Nehru Science Centre, Mumbai, was specifically selected as the case study framework because it stands as India's largest interactive science facility operational in a high-density urban economic zone and prominent domestic tourist hub. This renders the centre uniquely qualified to illustrate how structural scale, continuous infrastructure modernization, and tactical public outreach directly optimize cultural tourism assets while scaling informal STEM literacy within a developing nation paradigm.

2. Literature Review

The role of museums has undergone a significant transformation in recent decades, evolving from primarily repositories

of artifacts to dynamic centres for education, culture, and tourism. This literature review examines the diverse contributions of museums, with a particular focus on science museums, in promoting tourism development and enriching cultural landscapes [1, 2].

2.1. Museums as Tourism Drivers

Museums have increasingly become essential components of the tourism industry, drawing visitors through their unique offerings and experiences [20]. The relationship between museums and tourism is symbiotic, with museums enhancing a destination's appeal and contributing to its economic vitality. Research indicates that museums not only attract tourists but also encourage them to extend their stay and explore other local attractions, thereby providing a boost to the overall tourism economy. Cultural tourism, within which museum tourism is a significant subset, continues to gain popularity, emphasizing the importance of cultural attractions in providing learning environments that strengthen visitors' cultural understanding and consolidate cultural identity [6].

2.2. The Educational Role of Science Museums

Science museums play a crucial role in informal science education by making complex scientific concepts accessible to a broad audience [8]. Through interactive exhibits and hands-on activities, these museums stimulate curiosity and promote scientific literacy. Literature highlights the importance of science museums in complementing formal education by providing experiential learning opportunities that can inspire lifelong learning and engagement with science [10, 15]. By bridging the gap between theoretical concepts and real-world applications, science museums help students understand how scientific principles translate into tangible results. This hands-on approach fosters a growth mindset, encouraging students to embrace challenges and learn from mistakes, ultimately igniting a passion for STEM fields [5].

2.3. Gaps in Literature

While existing literature offers valuable insights into the roles of museums in tourism and cultural development, there is a need for more focused research on the specific impact of science museums in the Indian context. Case studies analyzing the strategies and outcomes of collaborations between science museums and travel agencies in India, the integration of science museum learning into the Indian educational curriculum, and the economic impact of science museums on local tourism industries would contribute significantly to the field. Furthermore, research on the innovative programs implemented by science museums in India, particularly in response to challenges like the COVID-19 pandemic, would provide valuable insights for museum professionals and stakeholders.

3. Methodology

The study utilizes a mixed-methods approach, incorporating both quantitative and qualitative data. Primarily, the visitor statistics from 2017 to 2024 will be analyzed to identify trends and patterns in visitor numbers, including the impact of collaborations with travel agencies during the Year 1995-1996.

3.1. Quantitative Analysis: Visitor Statistics

The primary quantitative data source for this study is the visitor statistics of NSCM, spanning the period from 1977 to 2024 [3, 11]. This data includes:

- 1) Total Visitor Numbers: Annual visitor counts, providing an overview of overall footfall trends.
- 2) Visitor Demographics: Data on visitor categories, such as school groups, families, and individual tourists, allowing for an analysis of visitor diversity.
- 3) Impact of Specific Programs: Assessing the impact of specific events and exhibitions on visitor attendance through comparative analysis.

These statistics were analyzed using descriptive statistics and time-series analysis to identify trends, patterns, and correlations. Predictive modeling was also employed to assess the potential impact of specific initiatives on future visitor numbers [16].

3.2. Qualitative Analysis: Programmatic Reviews

In addition to quantitative data, this study incorporates qualitative insights derived from:

- 1) Review of NSCM's Educational Programs: Evaluation of the content, delivery, and impact of educational programs, including school workshops, science demonstrations, and interactive exhibits.
- 2) Assessment of Community Engagement Initiatives: Evaluation of NSCM's outreach programs, community events, and public engagement activities [4].
- 3) Contextual Analysis of COVID-19 Adaptation: Review of NSCM's strategies for adapting to the challenges posed by the COVID-19 pandemic, including the implementation of virtual programs and online resources.

This qualitative analysis was conducted through document reviews, program evaluations, and contextual analysis of NSCM's strategic initiatives.

3.3. Data Collection and Analysis Tools

- 1) Data related to visitor number was provided by the Nehru Science Centre Administration, Official Website [3, 10, 11].
- 2) MS Excel and Google Sheets were used for data analysis and graphical representation.
- 3) OLS Regression Analysis using Python Coding and Plotting of Data.

3.4. Hypothesis Model: Linear Trend Validity

- 1) Null Hypothesis (H0): A linear model adequately represents the trend of visitor numbers across the entire time period.
- 2) Alternative Hypothesis (H1): A non-linear model provides a better fit for the trend of visitor numbers across the entire time period.
- 3) Analysis: Compare the goodness-of-fit of linear regression models with non-linear models (e.g., polynomial regression) using statistical measures like R-squared or AIC/BIC.

4. Results

This section presents the findings of the study, focusing on the quantitative analysis of visitor statistics and the qualitative insights derived from programmatic reviews.

4.1. Quantitative Analysis

4.1.1. Infrastructure of Nehru Science Centre, Mumbai (NSCM)

Since its inception, the NSCM has developed a comprehensive infrastructure to support its mission of science popularization and education. The centre, conceived in the late 1960s and taking shape as India's one of the largest interactive science centres by 1977 with the opening of the 'Light & Sight' exhibition, followed by the Science Park in 1979, was fully opened to the public in 1985. The centre boasts a sprawling 6 acres (24,000 sq. m.) of science park, housing over 500 hands-on and interactive exhibits on various aspects of science and technology [3, 11].

Table 1. Galleries & Facilities of NSCM.

Sl.No.	Names of the Galleries/Facilities	Floor Area sq. m.	Date of Inauguration	Date of major Renovation	No. of Exhibits
1	Reception Hall	385	11-Nov-1985	-	13
2	Sound & Hearing	385	15-Sep-2017	-	50

Sl.No.	Names of the Galleries/Facilities	Floor Area sq. m.	Date of Inauguration	Date of major Renovation	No. of Exhibits
3	Light & Sight	370	11-Nov-1985	29-Mar-2007	72
4	Science for Children	545	11-Nov-1985	2-Nov-2007	68
5	Human & Machine	565	28-Dec-1996	5-Apr-2010	56
6	Prehistoric Animal Life	300	21-Jun-2003	27-May-2011	43
7	Our Technology Heritage	400	9-Oct-2006	-	50
8	Hall of Nuclear Power	700	20-Aug-2011	24-Mar-2025	70
9	Climate Change	368	5-Jun-2012	Dismantled	58
10	Mirror: the reflecting surface	180	23-Jun-2015	-	42
11	Hall of Evolution	240	6-Oct-2025	-	30
12	Machined to Think	380	8-May-2018	-	17
13	Hall of Aviation & Space	550	28-Feb-2022	-	52
14	Linguistic Diversity of India (Temporary Exhibition)	368	23-Nov-2021	31-Jan-2025 (Dismantled)	24
15	Dinosaurs Among Us (Temporary Exhibition)	368	28-Feb-2025	-	19
16	Science on a Sphere	200	5-Jun-2016	-	-
17	Science Odyssey	1350	19-Dec-2008	-	-
18	Innovation Hub	185	24-Feb-2014	-	-
19	Motion Simulator	120	8-Mar-2020	-	-
20	Biotechnology Lab	190	26-Nov-2024	-	-
21	Science Park	6 Acres	24-Nov-1979		56

Table 1 highlights the continuous development of the Nehru Science Centre's infrastructure over the years. Starting with key galleries like Light & Sight and Science for Children, which were inaugurated in 1985, the centre has expanded to include a diverse range of thematic galleries and modern facilities such as the Science on a Sphere (inaugurated in 2016) and the Innovation Hub (established in 2014). The presence of temporary exhibitions like "Linguistic Diversity of India" and "Dinosaurs Among Us" indicates the centre's commitment to offering fresh and engaging content to its visitors. Major renovations to galleries like Light & Sight and Science for Children in 2007, and Human & Machine in 2010, demonstrate the ongoing efforts to maintain and update the exhibits. The upcoming inauguration of the Hall of Evolution in October 2025 and the recent Hall of Aviation & Space in February 2022 further showcase the centre's dedication to expanding its offer-

ings and keeping pace with advancements in science and technology. The Science Park, established in 1979, continues to be a significant attraction with its numerous outdoor exhibits.

4.1.2. Educational Programs - Science Demonstration Lectures (SDL) and Science Shows

As part of its educational programs, the NSCM conducts Science Demonstration Lectures (SDL) and Science Shows both within the centre and at outreach locations. These interactive sessions aim to engage students and the public with fundamental scientific concepts through demonstrations and engaging presentations. The following table (**Table 2**) provides details of the Science Demonstration Lectures (SDL) and Science Shows conducted [3, 11] by the NSCM, during the years 2017-2018 to 2023-2024:

Table 2. Educational Activities: Science Demonstrations.

Year	Science Demonstration Lectures (SDL) / Special Shows	No. of Lectures held in Science Centre	No. of Students Attended the lecture in NSC	No. of Lectures held outside Science Centre	No. of Students Attended the lecture outside
2017-18	Fun with Physics Science vs Miracles Properties of Air Colorful Chemistry Electricity & Magnetism Matter at Low Temperature Thermo-chemistry Sound Spark Theatre	1090	39898	151	45659
2017-18	Special Shows- I am a Mother & other public demonstration	1050	38414	45	
2018-19	Fun with Physics Science vs Miracles Properties of Air Colorful Chemistry Electricity & Magnetism Matter at Low Temperature	1307	51566	495	156470
2018-19	Special Shows Spark Theatre & I am a Mother	217	5729		
2019-20	Fun with Physics Science vs Miracles Properties of Air Colorful Chemistry Matter at Low Temperature	1259	43024	302	90889
2019-20	Special shows Spark Theatre & I am a Mother	825	16969		
2020-21	Fun with Physics Science vs Miracles Properties of Air Colourful Chemistry Matter at Low Temperature Special shows: Spark Theatre I am a Mother SOS Shows	342	5729	580 (online)	60,000 (view-ers*)
2021-22	No physical demonstrations were conducted due to Covid restrictions	-	-	-	-
2022-23	Fun with Physics Science vs. Miracles Properties of Air Colorful Chemistry Matter at Low Temperature	254	13057	105	48669
2022-23	Special shows Sparkling High Voltage	320	9821		
2023-24	Fun with Physics Science vs. Miracles Properties of Air Colorful Chemistry Matter at Low Temperature	160	9600	378	75600

Year	Science Demonstration Lectures (SDL) / Special Shows	No. of Lectures held in Science Centre	No. of Students Attended the lecture in NSC	No. of Lectures held outside Science Centre	No. of Students Attended the lecture outside
2023-24	Special shows Sparkling High Voltage Science show (at reception)	1452	31283		

* The viewers comprise the virtual participants who attended the online science demonstration lectures / science shows delivered by NSCM officials via various social media platforms.

- 1) The data reveals that NSCM consistently organized a significant number of Science Demonstration Lectures, Special Shows, featuring demonstrations like "Spark Theatre," "I am a Mother," and "Sparkling High Voltage", also garnered considerable attention. The years 2020-21 and 2021-22 saw a halt in offline activities due to the COVID-19 pandemic restrictions. Though demonstrations using online platforms like Facebook etc. gained popularity during the lockdown period.
- 2) However, the programs resumed in 2022-23 and 2023-24, indicating the centre's continued commitment to science education and public engagement.
- 3) The outreach lectures played a crucial role in extending the benefits of these educational programs to students beyond the immediate vicinity of the science centre.

4.1.3. Educational Programs - Science Shows, Popular Science Lectures (PSL), Sky Observation Programs, Other Activities

NSCM offers a wide array of educational programs, including film shows, science lectures, sky observation programs, and interactive activities. It is to be highlighted that 'No of-line activities could be conducted in 2020-21 due to Covid-19 Pandemic restrictions, however the online programs were specifically curated and conducted successfully even with subscription modes for the participants. The following table (Table 3) provides a detailed overview of these programs [3] and their reach between 2017-18 and 2023-24:

Table 3. Educational Activities: Science Show, Lectures, Panel Discussions, Sky Observations, Webinar, Quiz etc.

Category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Film Show at the Centre	3	49	98	-	-	2	4
Visitors	800	5485	7393	-	-	550	1650
Film Show at MSE Sites	192	395	260	-	-	317	609
Visitors	47785	125120	88342	-	-	50538	129937
Film Festival	17	45	21	-	-	-	1
Visitors	18481	5771	2919	-	-	-	1127
Popular Science Lectures	22	67	120	50 (Online)	15	19	15
Audience	4758	9263	14762	76432	22838	13433	4563
Panel Discussion	-	-	-	6 (Online)	-	-	-
Audience	-	-	-	7200	-	-	-
Science Webinar	-	-	-	10 (Online)	-	-	-
Audience	-	-	-	8230	-	-	-
Science Odyssey	-	-	-	-	506	1934	1917
Audience	-	-	-	-	13256	176226	199551
Science Quiz	43	59	109	44 (Online)	-	109	39
Participants	2055	2325	2632	21785	-	4229	1849
Audience	650	1065	880	16185	-	5259	2348

Category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Sky Observation at Centre	20	40	46	47 (Live streaming)	4	84	57
Participants	1380	1630	3400	881300 (Viewers)	3425	9271	5864
Sky Observation at MSE Sites	Not Introduced	Not Introduced	21	-	-	62	162
Participants	-	-	7475	-	-	17361	11887
Sky Observation outside Centre	-	-	-	-	-	-	7
Participants	-	-	-	-	-	-	876
Science on A Sphere Show	822	1012	1190	-	1084	2113	2003
Visitors	44351	55535	63045	-	16000	117433	119131
3D Science Shows	2416	2510	530	-	881	4572	4514
Audience	73223	95766	13427	-	13427	175010	163827
Online Science Shows	-	-	-	36	-	-	-
Viewers	-	-	-	4300	-	-	-
Sessions at Innovation Hub	194	146	152	170 (Online)	-	36	43
Participants	5006	20655	15261	2347	-	87	90
Motion Simulator Show	-	-	-	-	2608	7776	5373
Visitors	-	-	-	-	35880	96360	55060

Key observations include:

- 1) Wide Reach: The centre engages a significant number of visitors through various programs, both within its premises and through outreach initiatives like the Mobile Science Exhibition (MSE).
- 2) Popularity of Immersive Experiences: Programs like the Science on a Sphere and 3D Science Shows consistently attract large audiences, indicating the effectiveness of immersive and interactive formats in science communication.
- 3) Strong Interest in Astronomy: The introduction and subsequent popularity of the Taramandal/Planetarium/Odyssey shows, along with the consistent engagement in sky observation programs, demonstrate a strong public interest in astronomy.
- 4) Adaptation During Pandemic: While the years 2020-21 saw a dip in activities due to the COVID-19 pandemic restrictions, the centre adapted by offering online lectures, live streaming of sky observation and virtual engagement, as seen in the online webinars, Popular Science Lectures and Sky observation programs.
- 5) Focus on Outreach: The continued efforts through the

MSE program to reach visitors in remote areas and aspirational districts underscore NSCM's commitment to inclusive science education.

- 6) Innovation Hub Engagement: The Innovation Hub provides a platform for nurturing creativity and innovation among students, although participation numbers have varied.

4.1.4. Educational Programs - Mobile Science Exhibition (MSE) Bus and its activities

NSCM actively conducts outreach programs to reach diverse populations, especially in rural areas, through its MSE Bus. This initiative, supported by NCSM, aims to communicate science and foster a scientific temper among those who may not have easy access to the science centres. The MSE program utilizes specially designed buses equipped with interactive exhibits on various themes of science and technology, taking these exhibitions directly to schools and communities in remote locations. The following table (Table 4) provides details of the Mobile Science Exhibition (MSE) Bus program [3] conducted by Nehru Science Centre, Mumbai, during the years 2017-2018 to 2023-2024.

Table 4. *Mobile Science Exhibition Bus.*

Year	Theme of MSE Bus Exhibition	No. of Exhibition Days	Km Travelled	No. of Exhibition Sites	No. of Visitors
2017-18	Curriculum Based	101	3119	55	105372
2018-19	Curriculum Based	129	5506	85	141114
	Curriculum Based	132	2619	68	106234
2019-20	Hygiene & Sanitation (for Aspirational district)	92	3555	44	34290
2020-21	No activity took place due to covid pandemic restrictions				
2021-22					
	Curriculum Based	83	2387	52	42119
2022-23	Hygiene & Sanitation	83	1400	43	25081
	Curriculum Based	120	1621	71	66271
2023-24	Hygiene & Sanitation	125	2920	98	106972
	Vaccine - Injecting Hope	46	1095	15	23108

The number of exhibition days, kilometers traveled, sites visited, and visitors reached highlight the significant impact of this initiative in taking science education to a wider audience, especially in areas with limited access to formal science centres.

4.1.5. Educational Programs - Creative Ability Centre (CAC) Activities

The Creative Ability Centre (CAC) at NSCM plays a cru-

cial role in nurturing creativity, innovation, and scientific curiosity among students and the public. It is quite commendable that no offline activities could be conducted in 2020-21 due to COVID-19 Pandemic restrictions, however the online programs were specifically curated and conducted successfully even with subscription modes for the participants. The following table provides a detailed overview of the CAC's activities [3] from 2017-18 to 2023-24:

Table 5. *Creative Ability Centre Activities.*

Activities	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Science Fair / Festival / Camp	Zonal Level Sc Fair	Zonal Level Sc Fair				Zonal Level Sc Fair	Camp with NGO
Schools Participated	48	44	-	No programs could take place due to Covid Pandemic restrictions		36	3
Participants	89	88	-			67	137
Projects	45	44	-			37	102
Visitors	6439	6100	-			5638	
Innovation Festival							
Schools/ Institutes Participated	-	52	8			11	-
Participants	-	153	31	No programs could take place due to Covid Pandemic restrictions		-	-
Projects	-	52	31			-	-
Visitors	-	9000	7000			5638	-
Indian National Junior Astronomy Olympiad OCSC							
Schools Participated	Conducted by other centres of NCSM			Could not be conducted due to Covid			19

Activities	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Participants				Pandemic restrictions			20
Science Seminars	Regional Level	Regional Level	Regional Level			Regional Level	National Level
Participants	11	11	11	Could not be conducted due to Covid Pandemic restrictions		7	32
Schools Participated	11	11	11			7	32
Audiences	200	380	82			136	247
Vacation Hobby Workshop							
Number of Workshops	31	38	30	42	-	15	25
Participants	880	875	806	2663 + 3200 (online)	-	186	428
Projects	270	208	224	-	-	47	2568
Other Activities (Participants)							
Painting Contest	463	488	2079	-	427	-	316
Slogan Writing - Offline	233	126	660	-	-	-	6
Slogan Writing - Online	-	-	-	-	107	-	-
Quiz	1150	1509	1839	-	-	162	5083
Quiz - Online	144	-	-	-	11250	12337	-
Hindi Essay	10	48	-	-	-	-	-
Rangoli Competition	6	8	55	-	-	-	-
Elocution Contest - Offline	72	23	55	-	-	-	41
Elocution Contest - Online	-	-	-	-	11	-	-
Dance Competition	40	-	-	-	-	-	-
Poster Making Contest	-	150	-	-	-	-	-
Robotic Competition	-	260	72	-	-	-	-
Workshop-Offline	-	380	855	-	-	-	-
Online Workshop	-	-	-	-	1797	-	-
Traditional Art Forms	-	77	279	-	-	-	-
Panel Discussions	-	-	72	-	-	-	-
DIY - Take Home Activity	-	-	286	-	-	-	3326
Online Essay Writing Contest	-	-	59	-	-	-	-
Street Play Contest	-	-	187	-	-	-	348
Story Telling	-	-	30	-	-	-	-
Tree Plantation	-	-	215	-	-	-	-
Treasure Hunt Contest	-	-	14	-	-	-	80
Inter School Band Competition	-	-	97	-	-	-	-
Fancy Dress	-	-	8	-	204	-	-

This comprehensive data (Table 5) highlights the diverse activities conducted by the Creative Ability Centre. Key observations include:

- 1) Educational Enrichment: Science Seminars at the Regional and National level offer valuable opportunities for students and educators to delve deeper into scientific topics and interact with experts.
- 2) Hands-on Learning: Vacation Hobby Workshops and the Creative Ability Centre programs within and outside the Science Centre provide hands-on experiences that encourage creativity and practical application of scientific principles. The significant number of participants in CAC programs outside the centre in recent years indicates a strong outreach effort.
- 3) Diverse Creative Outlets: A wide array of creative programs and competitions, including painting, slogan writing, quizzes, essay writing, rangoli, elocution, dance, poster making, robotics, and workshops, cater to varied interests and nurture different skills. The shift towards

online competitions and workshops during the pandemic broadened the reach of these activities.

- 4) Community Engagement: The CAC actively engages the community through events like science fairs and various creative competitions, fostering a culture of science and creativity beyond the formal education system.

4.1.6. Educational Programs - Training Activities

NSCM also conducts various Educational Training Programs aimed at teachers, students, and the public to enhance their skills and knowledge in specific areas of science and technology. It is to be considered that 'No offline activities could be conducted in 2020-21 due to Covid-19 Pandemic restrictions, however the online programs were specifically curated and conducted successfully even with subscription modes for the participants. The following table provides details of these programs [3] from 2017-18 to 2023-24:

Table 6. Educational Activities: Training Programs.

Category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Teachers' Training Programs (TTP)							
Programs	2	5	3	2	8	3	2
Teachers Trained	60	254	101	168	408	123	76
Teaching Aids / Kits developed	4	10	16	10	30	84	304
Computer Training Programs							
Programs	1	1	1	-	-	-	-
Participants	21	20	24	-	-	-	-
Astronomy & Telescope Making Program							
Programs	1	2	3	2	2	2	4
Participants	24	53	61	53	323	44	273
Projects Made	6	14	20	14	5	256	12
Aeromodelling							
Programs	3	3	3	4 (online)	7	5	3
Participants	67	67	77	236	403	65	30
Models Made	21	24	27	12	32	6	165
Model Rocketry							
Programs	4	4	3	-	1	6	3
Participants	86	115	86	-	80	74	58
Models Made	28	20	13	-	6	370	16

This data (Table 6) highlights the diverse educational training programs offered by NSCM:

- 1) Teachers' Training Programs (TTP): These programs show a consistent effort to enhance the skills and knowledge of teachers in science education. The significant increase in the number of teachers trained and teaching aids/kits developed in 2021-22 and 2023-24 indicates a strong focus on empowering educators.
- 2) Computer Training Programs: While fewer in number, these programs provide essential digital literacy skills to participants.
- 3) Astronomy & Telescope Making Program: This program fosters interest in astronomy and provides hands-on experience in telescope making, with a notable increase in participants and projects made in 2021-22 and 2023-24.
- 4) Aeromodelling: The aeromodelling training introduces

participants to the principles of flight and model aircraft construction, with consistent program offerings and a significant number of models made in 2023-24.

- 5) Model Rocketry: This program engages participants in the exciting field of rocketry, providing both theoretical knowledge and practical model building experience, with a high number of models made in 2022-23.

4.1.7. Educational Programs - Community Programs & Commemorative Day Events

Nehru Science Centre is actively involved in various community programs aimed at promoting scientific temper, addressing social issues through science, and engaging the wider public. The following table provides details of these programs [3, 12] from 2017-18 to 2023-24:

Table 7. Community Programs & Commemorative Day Events.

Category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Development of Scientific Temper							
Programs	133	151	223	151	4	106	23
Audience	45659	41706	47812	41706	2065	52139	20331
Science Drama: Theme	Swachh Bharat: Role of Science and Technology and Green Energy	Science & Society	Could not be organized due to covid-pandemic		Science and Technology for the benefit of mankind		
Regional Level							
Schools	9	-	10	-	-	-	-
Participants	72	-	90	-	-	-	-
Audiences	260	-	150	-	-	-	-
Zonal Level							
Schools	10	11	12	-	-	12	5
Participants	90	99	108	-	-	120	60
Audiences	230	220	250	-	-	350	310
National Level							
Schools	10	-	-	-	-	-	10
Participants	100	-	-	-	-	-	120
Audiences	150	-	-	-	-	-	469
Other Community Programs & Commemorative Day Events							
World No Tobacco Day			Outreach programmes in rural area				
World Water Day			Science Drama				
Science and Miracles shows			Innovation Festival				
Outreach programmes in rural area			Solar & Lunar Eclipse Program				
World Environment Day			Constitution Day				
International Day of Yoga			National Unity Day				
World Ozone Day			Moon Landing Day				

Category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Earth Day			Engineers Day				
Swachh Bharat Abhiyan			Aviation Day				
World Autism Day			National Science Day				
International Women's Day			Remembering Dr. Vikram Sarabhai				
Marathi-Malayali Ethnic Fest			Hands-on Drone workshop				
Puppet show			Drone workshop-cum competition				

This data of [Table 7](#) highlights the Nehru Science Centre's commitment to community engagement:

- 1) Development of Scientific Temper: NSCM actively conducts programs aimed at fostering a scientific mindset within the community, reaching a significant audience over the years.
- 2) Science Drama: The centre utilizes science drama to communicate scientific and social themes, with participation at regional, zonal, and national levels, indicating

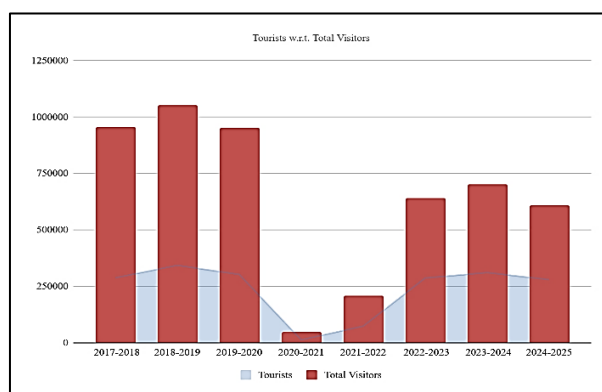
a wide reach and engagement, connecting science with culture.

- 3) Other Community Programmes: NSCM organizes a diverse range of programs focusing on important days, scientific phenomena, and social issues, demonstrating its role as a community hub for science awareness and engagement.

4.1.8. Visitor Statistics of Nehru Science Centre, Mumbai [3, 12]

Table 8. Visitor Statistics (Year 2017-2024).

Financial Year (April to March)	Group visits	Students	General Visitors	Tourists	Total visitors
2017-18	1745	116577	499207	287431	957206
2017-19	1911	124830	513187	343047	1051567
2019-20	1760	112956	459543	302376	953676
2020-21	5	1999	32806	12809	47614 (Online Attendance 4677616)
2021-22	66	6518	126021	73474	208690
2022-23	1377	139471	501952	286698	641423
2023-24	1451	121986	553992	310889	703509
2024-25	1446	117938	463494	279349	608459



Highlight: The comparison of Tourists to Total Visitors in Pre-Pandemic & Post-Pandemic Scenario.

Figure 1. Comparison of Tourists with respect to total visitors to the science centre.

Table 9. Visitor Statistics (Year 1977-2024).

Year (Jan - Dec)	Groups (Students)	Students	General Visitors	Total (Excluding Outreach Visitors)
1977	64	3898	6591	10489
1978	199	11225	35678	46903
1979	499	39764	43280	83044
1980	828	44618	83958	128576
1981	800	50801	72489	123290
1982	406	33994	57806	91800
1983	424	38218	57732	95950
1984	367	35919	61731	97650
1985	459	42536	108354	150890
1986	1253	108804	150899	259703
1987	1269	108250	151640	259890
1988	1290	104737	165698	270435
1989	1395	110395	172744	283139
1990	3092	119561	186358	305919
1991	1057	78531	190772	269303
1992	1278	105052	201877	306929
1993	920	73917	168054	241971
1994	1159	105112	197894	303006
1995	1058	105120	205966	311086
1996	1153	104823	283890	388713
1997	1341	124136	375577	499713
1998	1416	132726	476234	608960
1999	1217	100223	401848	502071
2000	1337	104792	396691	501483
2001	1353	124223	377931	502154
2002	1475	126804	384474	511278
2003	1458	130671	439469	570140
2004	1663	177489	454926	632415
2005	1638	154250	467154	621404
2006	1780	158481	474312	632793
2007	1606	172705	527265	699970
2008	1435	150854	520563	671417
2009	1984	185880	549469	735349
2010	2130	197094	508532	705626
2011	2452	221900	542608	764508
2012	2323	205671	575551	781222
2013	2378	215668	529178	744846

Year (Jan - Dec)	Groups (Students)	Students	General Visitors	Total (Excluding Outreach Visitors)
2014	2189	218679	503890	722569
2015	2065	222792	492611	715403
2016	1998	182238	520186	702424
2017	1781	179676	501882	681558
2018	1887	183398	511855	695253
2019	1928	207159	481284	688443
2020	531	55412	85285	140697
2021	30	5177	101270	106447
2022	848	84933	438074	523007
2023	1409	152153	563098	715251
2024	1468	143994	464084	608078

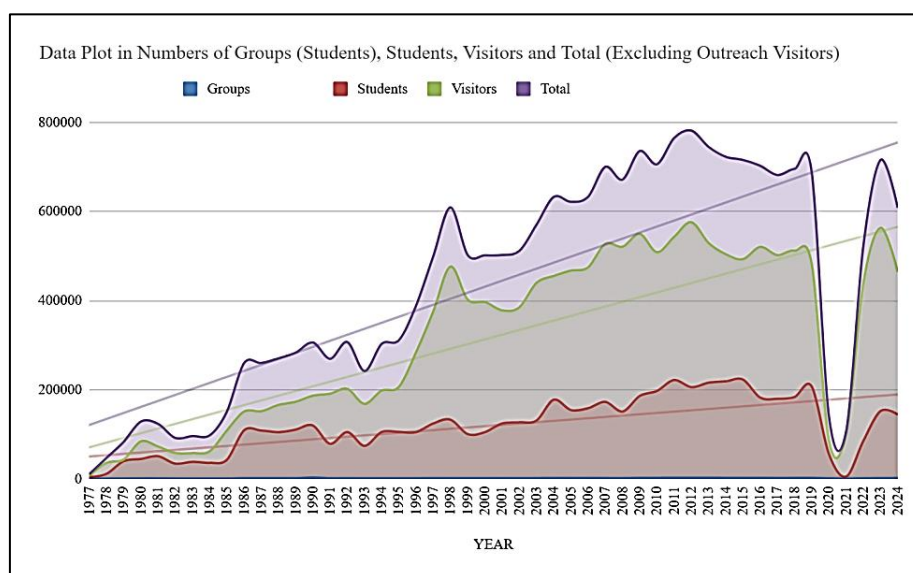


Figure 2. Comparison of student groups, students and general visitors with respect to total visitors from the establishment of science centre.

The data from (Table 8 and Table 9) highlights that the *Significant increase in visitor figures after 1995*, and this has happened after collaborating with the *Local Tourist Bus operators* like ‘Mumbai Darshan’, ‘Mumbai Safari’, ‘Neeta Travels’ etc [9].

4.2. Overview of the Mathematical Models for Visitor Statistics

The analysis of visitor statistics (Table 8 and Table 9) from 2017 to 2024 and overall period from 1977 to 2024 reveal several key trends and patterns:

1) Linear models, in the form of $y = m \cdot x + c$, have been

chosen for each period as a simplified yet informative way to understand the general direction and rate of change in visitor numbers. Here, ‘y’ represents the number of visitors, and ‘x’ represents the year. The parameter ‘m’ signifies the slope of the line, indicating the estimated annual change in visitor numbers, while ‘c’ is the y-intercept, representing the theoretical number of visitors in year zero, which may not have a practical interpretation within the context of this analysis.

2) The estimated parameters for the linear models, derived using Ordinary Least Squares (OLS) regression on the provided data for each visitor category and time period, are presented in the following summary table.

Table 10. Linear Model - Summary of Mathematical Models for Visitor Statistics of NSCM.

Visitor Category	Time Period	Mathematical Model	Estimated Parameters
Groups	1977-1984	$y = m_1 * x + c_1$	$m_1 \approx 436.46, c_1 \approx -861214.57$
	1985-2019	$y = m_2 * x + c_2$	$m_2 \approx 445.43, c_2 \approx -860824.23$
	2022-2024	$y = m_3 * x + c_3$	$m_3 \approx 3001.50, c_3 \approx -6047915.00$
Students	1977-1984	$y = m_1 * x + c_1$	$m_1 \approx 603.04, c_1 \approx -1181829.71$
	1985-2019	$y = m_2 * x + c_2$	$m_2 \approx 411.38, c_2 \approx -787122.95$
	2022-2024	$y = m_3 * x + c_3$	$m_3 \approx -1021.50, c_3 \approx 2074360.00$

Table 10 provides a structured overview of the estimated linear relationships between visitor numbers and time for different segments of the centre's audience across the three defined periods. The analysis in the following section will delve deeper into the interpretation of these parameters and the

trends they represent.

To facilitate a clearer comparison of the rate of change in visitor numbers across different categories and time periods, the slope values ('m') from the provided models are summarized in the table below:

Table 11. Estimated Annual Change in Visitor Numbers (Slope 'm') by Category and Period.

Visitor Category	Pre-opening Slope (m1)	Post-opening Pre-pandemic Slope (m2)	Post-pandemic Recovery Slope (m3)
Groups	436.46	445.43	3001.50
Students	603.04	411.38	-1021.50

- 1) Pre-opening (1977-1984): A positive slope of both the categories indicates a steady and significant increase.
- 2) Post-opening, Pre-pandemic (1985-2019): Steady higher positive slopes confirm a strong growth trend in both the categories of visitors, likely driven by the centre's opening with additional facilities.
- 3) Post-pandemic Recovery (2022-2024): A large negative slope of -1021.50 reveals a substantial decline in number of Students Visits. This could be impacted due to the pandemic restrictions, general election of the nation during the peak seasons, environmental conditions like extreme heat wave etc.
- 4) Historical baseline validation using the long-term records in Table 9 establishes that from a modest launch footprint of 10,489 total visitors in 1977, NSCM systematically scaled its societal footprint, crossing the half-million annual visitors mark by 1998. This long-term evolution underlines the massive scaling power of the museum's service vector. By deploying the calculated pre-pandemic growth metric ($m_2 \sim 445.43$ for group visits) alongside the post-pandemic recovery slope ($m_3 \sim 3001.50$), short-term predictive tracking forecasts that total baseline annual footfall numbers are statistically positioned to transcend the 780,000 thresholds within

the 2027–28 operating cycle, assuming standard environmental conditions and stable academic calendars.

4.3. Goodness-of-Fit Criteria for the Data and Hypotheses Model

The goodness-of-fit of linear versus polynomial regression models using R-squared. The desired analysis has been carried out with the Python Code and the corresponding interpretation of the results are as follows.

Table 12. R-squared values for both linear and polynomial models.

Category	Linear R ²	Poly 2 R ²	Poly 3 R ²
Groups	0.3396	0.3409	0.3429
Students	0.1805	0.1818	0.1822
Visitors	0.3207	0.3458	0.4578
Total	0.3263	0.3486	0.4611

Interpretation of the Results:

Groups: The R-squared values are quite consistent across linear, quadratic (Poly 2), and cubic (Poly 3) models. The increase in R^2 is very minimal when using polynomial models. This indicates that a linear model fits the "Groups" data reasonably well, and adding polynomial terms does not significantly improve the fit.

Students: Similar to "Groups", the R-squared values remain relatively consistent across all models. There is very little to no increase in R^2 values when using polynomial models. Therefore, a linear model is sufficient.

Visitors: There is a noticeable increase in R-squared as we move from a linear model to a quadratic and then a cubic model. Specifically, the cubic model (Poly 3) shows a relatively significant improvement in the model fit. This suggests that the trend in "Visitors" data is better captured by a non-linear model, likely due to the sharp changes in recent years. The pattern for "Total" is very similar to "Visitors".

Hypotheses Testing:

"Groups" and "Students":

Linear model appears to be sufficient. The data doesn't strongly indicate a need for more complex polynomial models.

"Visitors" and "Total":

A cubic polynomial model provides a significantly better fit. This suggests that the trends in these categories are non-linear, and a cubic model is better at capturing the fluctuations, especially the sharp decline in recent years.

4.4. Qualitative Analysis: Programmatic Reviews

The qualitative analysis of NSCM's programs and initiatives provides valuable insights into the centre's impact on tourism, education, and cultural enrichment:

4.4.1. Collaboration with Travel Agencies and Tourism Impact

- 1) Strategic collaborations with travel agencies have been a key component of NSCM's strategy to enhance its visibility and position itself as a prominent destination for cultural and educational tourism. Significant increase in visitor figures after 1995, after collaborating with the Local Tourist Bus operators like *Mumbai Darshan*, *Mumbai Safari*, *Neeta Travels* etc.
- 2) Globally, examples of successful collaborations between museums and tourism entities highlight the potential benefits. For instance, UNESCO has partnered with the Boston Museum of Science to launch exhibitions on World Heritage sites, demonstrating how museums can leverage partnerships to raise awareness and attract visitors [19]. Liberty Science Centre in New Jersey actively promotes itself as a must-see destination and provides information on nearby lodging and transportation, effectively integrating itself into the local tourism infrastructure.

4.4.2. Impact of Ticketing Categories and Packages

- 1) NSCM offers a diverse range of ticketing categories and packages designed to cater to various visitor segments and enhance public engagement. These options include entry tickets for general visitors, discount rates for group visits and students (including those from government and municipal schools), and special packages for families. These packages often offer a more economical way for visitors to experience multiple offerings.
- 2) For instance, a package ticket combining the Science Centre and Science Odyssey is priced at ₹130 for general visitors, while separate tickets would cost ₹70 and ₹80 respectively. Special provisions also exist for BPL cardholders, offering entry at a nominal fee of ₹5. The availability of family packages, like the one including the Science Centre, Science Odyssey, 3D Show, SOS, and Motion Simulator with a complimentary Sparkling High Voltage Demonstration, priced at ₹600 for a family of 4 and ₹900 for a family of 6, further encourages family visits by providing a comprehensive and value-driven experience.

4.4.3. Integration of Museum-Based Learning into Educational Curricula

- 1) NSCM has successfully integrated its exhibits and programs into educational frameworks, fostering a culture of curiosity and scientific literacy among students. The centre's adoption of hybrid learning models and experiential pedagogy has enriched formal education while inspiring youth engagement with science.
- 2) Best practices for integrating museum learning into educational curricula emphasize the use of real objects, hands-on activities, and exhibitions to make learning more meaningful. Museums can also provide resources and professional development for teachers to align museum visits with curriculum standards [8].

4.4.4. Fostering the Culture of Tourism and Public Engagement with Science

- 1) NSCM has played a pivotal role in embedding a culture of tourism in society by emphasizing the value of museums as spaces for public learning and engagement. Science museums can employ various strategies to foster tourism culture and enhance public engagement with science. These include embracing smartphone culture by encouraging social media sharing like Facebook, Instagram Reels, X (Earlier known as Twitter), YouTube etc., hosting educational events, bringing exhibits to the community [3, 17].
- 2) The Association of Science and Technology Centres (ASTC) supports its members in building the civic capacities of their institutions and visitors, highlighting the role of science museums in addressing complex socio-

scientific issues [2]. NSCM, as a prominent science centre in India, likely employs a combination of these strategies to attract visitors and engage the public with the wonders of science.

4.4.5. Adaptation During the COVID-19 Pandemic

- 1) During the COVID-19 pandemic, NSCM adapted swiftly with virtual programs, demonstrating resilience and reinforcing the societal importance of museums. Science museums worldwide responded to the pandemic by rapidly increasing their digital engagement efforts.
- 2) They offered free online learning resources, access to digital collections, virtual tours, and online exhibits. Many museums moved their in-person experiences online, creating virtual field trips, online quizzes, podcasts, and 3D/Virtual tours of their spaces. The Museum of Science in Boston used artificial intelligence to create a virtual exhibit allowing people to ask questions about the coronavirus [14]. NSCM also implemented online lectures and virtual engagement during this period. For instance, NSCM organized the online Sky Observation Programs, Hands-On Experiments at Home, Electronics Circuitry like Arduino etc.

4.4.6. Economic Impact on Mumbai's Tourism Ecosystem

- 1) Through quantitative analysis, this study highlights NSCM's contribution to Mumbai's tourism ecosystem and its broader implications for cultural development. While the provided snippets do offer specific data on the direct economic impact of NSCM on Mumbai's tourism industry between 1995 and 2019, the general economic trends in museum tourism in India suggest a positive contribution.
- 2) In 2016, tourism in Mumbai generated INR 312 billion or 3.2% of the city's GDP and supported 637,900 jobs, 7.3% of its total employment. The sector was predicted to grow at an average annual rate of 8.8% to INR 720 billion by 2026 (3.1% of GDP). Science centres, in general, render valuable service to their communities and have a profound impact on local economies by attracting visitors. They are considered major tourist attractions and prime elements in cultural tourism [9, 13, 18]. NSCM, with its large annual visitor numbers exceeding 700,000, including a significant number of students, contributes to the local economy through visitor spending and by enhancing Mumbai's appeal as an educational and cultural destination.

5. Discussions

The consistently positive slopes observed for most visitor categories in the post-opening period (1985-2019) underscore the centre's success in attracting and engaging the public after

its inauguration in 1985. Interestingly, the higher growth rates in the pre-opening period for several categories suggest that initial outreach efforts and the development of early attractions like the 'Light and Sight' exhibition and the Science Park effectively generated public interest and anticipation. The transition from the pre-opening phase to the operational phase of the centre brought about a change in the growth dynamics for different visitor segments, highlighting the influence of the physical infrastructure and the ongoing programs offered [10].

The pre-pandemic era (1985-2019) was characterized by a healthy growth trajectory across most visitor categories, indicating the Nehru Science Centre's sustained relevance and appeal. This growth was likely supported by factors such as Mumbai's increasing population, a growing awareness of the importance of science education, the centre's established reputation as a leading science museum, and its diverse range of exhibitions and educational programs. With over 700,000 visitors annually, including a significant number of school children, the centre has become a cornerstone of science engagement in the region.

Examining broader tourism trends in Maharashtra can provide context for the Nehru Science Centre's visitor patterns. Maharashtra has historically been a popular tourist destination, attracting both domestic and international visitors, with Mumbai being a major hub. Tourist arrivals in the state experienced growth before the pandemic but were significantly impacted in 2020 and 2021. Recovery began in 2022 and continued into 2024, with Maharashtra ranking among the top states for both domestic and foreign tourist visits.

6. Recommendations

To gain a more comprehensive understanding of the visitor statistics and to facilitate more accurate forecasting, future analysis could explore the use of non-linear time series models such as exponential smoothing or ARIMA (Autoregressive Integrated Moving Average and it's a technique for time series analysis and for forecasting possible future values of a time series.) to capture potential complexities and saturation effects in visitor numbers [7].

Incorporating external variables such as economic indicators, regional tourism trends, and significant events could enhance the explanatory power of the models. A dedicated analysis of the pandemic years (2020-2021) would be valuable in quantifying the specific impact on each visitor category. Furthermore, evaluating the effectiveness of post-pandemic initiatives and considering visitor demographics, if available, could provide actionable insights.

Exploring the influence of hybrid learning models on visitor engagement could also be beneficial. Understanding these trends and their influencing factors is crucial for the Nehru Science Centre to strategically plan its future activities and continue its mission of promoting scientific temper and engaging the wider community.

7. Conclusion

Nehru Science Centre, Mumbai, stands as a significant institution playing a dual role as an engine for cultural enrichment and tourism development. Through its interactive exhibits, educational programs, strategic collaborations, diverse ticketing options, well-developed infrastructure, extensive outreach through the Mobile Science Exhibition, engaging Science Shows and Lectures, the activities of the Creative Ability Centre, comprehensive Educational Training Programs, impactful Community Programmes, and regular Commemorative Events, NSCM has made substantial contributions to fostering scientific temper and attracting visitors. The centre's resilience during the COVID-19 pandemic, marked by its swift adoption of virtual programs, further underscores its societal importance. As the tourism sector in India continues to grow, science museums like NSCM are well-positioned to leverage their unique offerings to contribute to local economies and promote a culture of scientific literacy.

8. Limitations

Linearity Assumption: The analysis heavily relies on linear regression, assuming a linear relationship between time (years) and visitor numbers. This may not accurately capture non-linear trends or cyclical patterns in visitor behavior.

External Factors: The analysis does not account for various external factors that could influence visitor numbers, such as:

- 1) Economic conditions
- 2) Changes in educational policies
- 3) Competition from other attractions
- 4) Marketing and promotional activities
- 5) The quality and changes in the exhibitions

Lack of Demographic Data: The research does not include demographic data about the visitors, for example, age, location, and the purpose of the visit. This data would greatly increase the research depth.

9. Future Scope

Non-Linear Modeling: Explore non-linear regression models (e.g., polynomial, exponential) or time series analysis (e.g., ARIMA) to capture more complex trends.

External Factor Analysis: Incorporate external variables into the analysis (e.g., GDP, education spending, marketing budget) to understand their impact on visitor numbers.

Granular Time Series Analysis: Analyze monthly or weekly visitor data to identify seasonal patterns and short-term fluctuations.

Demographic Analysis: Collect and analyze demographic data to understand visitor profiles and preferences. This can inform targeted marketing and program development.

Comparative Analysis: Compare visitor trends at Nehru Science Centre with those at similar science centres in India or internationally.

Visitor Feedback Analysis: Collect and analyze visitor feedback (e.g., surveys, online reviews) to understand visitor satisfaction and identify areas for improvement.

Abbreviations

NCSM	National Council of Science Museums
NSCM	Nehru Science Centre, Mumbai
COVID-19	Coronavirus Disease of 2019
STEM	Science, Technology, Engineering, and Mathematics
AIC / BIC	Akaike Information Criterion / Bayesian Information Criterion
MSE	Mobile Science Exhibition
CAC	Creative Ability Centre
SDL	Science Demonstration Lectures
PSL	Popular Science Lectures
TTP	Teachers Training Programme
SOS	Science on Sphere
OLS	Ordinary Least Squares
ARIMA	Autoregressive Integrated Moving Average
ASTC	The Association of Science and Technology Centres
GDP	Gross Domestic Product

Author Contributions

Tapas Kumar Moharana: Conceptualization, Formal Analysis, Methodology, Resources, Software, Visualization, Writing – original draft

Anindita Mondal: Data curation, Investigation, Project administration, Supervision, Validation, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Al Shueili, K. (2015). Towards a sustainable urban future in Oman: Problem and process analysis (Muscat as a case study). *Doctoral dissertation, The Glasgow School of Art.*
- [2] American Medical Association. (2004). *American Medical Association family medical guide* (4th ed.). Wiley.
- [3] Annual Activity Reports & Visitor Statistics. (2017-2024). Nehru Science Centre Administration. <https://nehrusciencecentre.gov.in/>
- [4] Association of Science and Technology Centres (ASTC). (2022, April). *Museum Digital Engagement: Before, During, and Beyond the COVID-19 Pandemic.* https://www.astc.org/wp-content/uploads/2022/05/ASTC_Museum-Digital-Engagement_Before-During-and-Beyond-the-COVID-19-Pandemic.pdf

- [5] D'Souza Aruna. (2018, June 21). *Museums Inspire STEM Learning for the Whole Family*. Carnegie Corporation of New York. <https://www.carnegie.org/our-work/article/all-family>
- [6] Chen, J. (2024). Factors Affecting Cultural Transmission in Museum Tourism: An Empirical Study with Mediation Analysis. *SAGE Open*, 1-17. <https://doi.org/10.1177/21582440241273868>
- [7] IBM. (2024, May 24). *What are ARIMA Models?* from <https://www.ibm.com/think/topics/arima-model>
- [8] Rautela, G.S., Sanyal, Indranil. (2014) Impact of Science Museums and Centres. *Propagation, National Council of Science Museums*, 1-11, from INDIAN CULTURE. <http://indianculture.gov.in/other-collections/impact-science-museums-and-centres>
- [9] Maharashtra Tourism Development Corporation (MTDC). *Official Website*: from <https://www.mtdc.com>
- [10] Master Journals. (2021). THE ROLE OF MUSEUMS IN THE DEVELOPMENT OF TOURISM. *CURRENT RESEARCH JOURNAL OF HISTORY* 2(10): 27-32.
- [11] Nehru Science Centre, Mumbai. *Activity Report - Nehru Science Centre, Mumbai*. from <https://nehrusciencecentre.in/publications/activity-report>
- [12] Nehru Science Centre, Mumbai. *Official Website*. <https://nehrusciencecentre.gov.in/>
- [13] India Tourism Statistics 2022. <https://static.pib.gov.in/WritereadData/userfiles/IndiaTourismStatistics2022English.pdf>
- [14] The Inclusive Museum Research Network. (2025). *Our Partners*, <https://onmuseums.com/about/our-partners>
- [15] Short Jim. (2014). How Can Museums Help Teachers With the NGSS? *Dimensions-The Metropolitan Museum of Art*. 27-31.
- [16] Choong-Ki Leea, Hak-Jun Songb, James W. Mjeldec. (2008). The forecasting of International Expo tourism using quantitative and qualitative techniques. *ScienceDirect-Tourism Management*, 29, 1084-1098. <https://doi.org/10.1016/j.tourman.2008.02.007>
- [17] *The Role of Museums in the Development of Tourism - Master Journals*, from <https://www.masterjournals.com/index.php/CRJH/article/download/388/344>
- [18] India Tourism Data Compendium Key Highlights 2024. Ministry of Tourism, https://tourism.gov.in/sites/default/files/2025-02/IndiaTourismDataCompendiumkeyhighlight202024_0.pdf
- [19] UNESCO World Heritage Centre. (2010, February 10). *UNESCO and the Boston Museum of Science launch an exhibition on World Heritage*. <https://whc.unesco.org/en/news/2650>
- [20] Zubitashvili, T. (2024). The Role of Museums for the Issue of Tourism Development. *Sciential Journal of Education Humanities and Social Sciences*, Vol. 2.1, 1-6.

Biography



Tapas Kumar Moharana, a Mechanical Engineer and Science Communicator, has over 14 years of experience in designing and curating innovative science exhibits. He holds dual Master's degrees in 'Manufacturing Processes and Systems' and 'Science Communication' and currently serves as a Curator at Nehru Science Centre, Mumbai, a unit of National Council of Science Museums (NCSM), India. Known for creating mechanical interactives and mobile science exhibits, he combines precision engineering with creative design. Skilled in SolidWorks, AutoCAD, Unity, CNC machining, and 3D printing, he has presented research internationally and authored publications on immersive technologies and exhibit design, contributing significantly to science education and public engagement.



Anindita Mondal is currently serving as a Curator (Science Communicator) at Nehru Science Centre, Mumbai under the National Council of Science Museums, Govt. of India. Holding a Ph.D. in Astrophysics from the University of Calcutta, her research specializes in multi-wavelength studies of novae, data modelling, and theoretical cosmology. With prior roles as post-doctoral researcher and lecturer, she has an extensive portfolio of publications in reputed journals and is the National Coordinator for the Indian National Junior Astronomy Olympiad Programme. She has over 5 years of experience in designing interactive exhibits and conducting educational programs promoting scientific literacy and public engagement.