## Report of BESTM Teacher Fellowship Programme CESME, HBCSE

(Under PMMMNMTT scheme of MHRD)



Homi Bhabha Centre for Science Education Tata Institute of Fundamental Research July 2019 CESME at HBCSE was set up in March 2019 with the aim of at strengthening science and mathematics education in India by engaging with teachers and teacher educators at school and undergraduate levels. The objectives of CESME at HBCSE are

- To develop and offer teacher professional development programmes that are well grounded in research in science and mathematics education
- To create a resource pool of teachers/teacher educators with awareness about research and research informed innovations in science and mathematics education
- To carry out capacity building of science (and mathematics) teachers at school/higher secondary/undergraduate level with respect to content and pedagogy
- To prepare field tested material/resources so as to impact science teaching and learning practices.

### BESTM teacher fellowship programme

One of the major activities under CESME at HBCSE is the *Building Educators for Science, Technology and Mathematics (BESTM)* teacher fellowship programme. The thrust of the BESTM is to empower teachers and teacher educators working at elementary, secondary, higher secondary and under-graduate levels to take leadership roles in their profession by exposing them to contemporary ideas and scholarship in field of STEM education. (See https://cesme.hbcse.tifr.res.in/teacher-fellowship-scheme)

The maximum fellowship to be awarded under this scheme is 25 per year. The fellowship programme would be conducted in dual mode, with contact periods of about 6 to 8 weeks in two phases and a distance mode spread over one academic year. Each BESTM teacher fellow will proceed with action research/investigatory project work in their own set-up and will write research reports about the work done.

The programme for the academic year 2019-2020, commenced on June 10, 2019. The 25 teacher fellows selected through a nationwide selection process came with diverse background and were involved with science/mathematics education at school / higher secondary/ undergraduate level. Some of them were involved with teacher education (see Annexure A for details about the teacher fellows). The first contact period was of four weeks; including the course work that had duration of two weeks.

As part of the course work, the BESTM teacher fellows interacted with eminent resource persons from across India and from HBCSE. Some of the themes for the course work were handling student diversity; introduction to STME research, research based teaching practices, research methodology, use of technology in education, leadership development, experimental investigations/mathematical explorations, etc. The teacher fellows were also introduced to academic reading sessions whereby each participant was provided research papers relevant to the field of STME education. In addition to the lecture series, field visits to CESME at IISER (Pune) and Nehru science centre were also a part of the course work. (See Annexure B for detail timetable). The course work concluded with participants attending the public lecture by Prof. Kasturirangan on new educational policy held at TIFR.

After completion of the course work, the teacher fellows interacted with their mentors so as to crystallise the action research project that they want to work with. These research and development proposals were presented by each participant during July 1-4, 2019 so that they get feedback from peers and faculty members from HBCSE. The current areas for BESTM projects are primarily related to a) development of resources for experimental domain with respect to biology, chemistry and physics education, b) development of resources/lesson plans/activities/worksheets for design and technology education c) mathematics education and d) Tinkering space/ICT for science and mathematics education. The teacher fellows were expected to work at their local levels for the projects and are expected to visit HBCSE during January to April, 2020, to complete their projects and the second contact phase. They were also encouraged to attend the established epiSTEME-8: A Biennial Conference Series to Review Research on Science, Technology and Mathematics Education, to be hosted by HBCSE in January 2020 as they will get an opportunity to interact with eminent people at the International level.

# Some of the representative feedbacks obtained from participants are as follows

"It introduced me to unexposed areas of science education research happening in India-Design research, misconceptions in relation to classroom teaching and questioning."

"Diversity of fellows selected and diversity of resource persons, flexibility in expression of ideas in the interactions, feedbacks without names so that everybody can express freely, are remarkable."

"BESTM programme was helpful in developing a new angle to view classroom related problems (Teaching-learning).It also inculcated research spirit in me."

"It is really very motivating to be among the people who have a strong desire to alter education systems and classroom teaching methods and that too from all over India."

"The programme was better than my expectations. It was enriching and fruitful."

"I have learnt how to express myself in a better way through broad ideas, better understanding and integrated approach."

"The whole idea and process of doing an action research (was remarkable). I wish to do PhD now in the field of education."

"I expected to learn and enhance my teaching-learning skills through this program. BESTM program truly provided me the right exposure to proceed in Biology Education Research and contribute in making U.G classrooms a better learning place."

"After this fellowship, I firmly believe that one needs to learn, research, improvise his/her teaching skills with teaching. Any degree/test cannot make you a good teacher. Teaching is beyond knowing and transferring the content/subject knowledge."

"I was expecting new methods for teaching science which helps me to teach my students. After the HBCSE fellowship I think, I received more, like to understand diversity of students, Predict-Observe-Explain (POE), Concept mapping etc. ....."

"This fellowship helps me to try to see inside the students' belief and perceptions. I think this exposure will help me to enhance my teaching."

"It has changed my perception about the society, the people as so on. I think I can understand my kids better after this program."

#### Slides of Presentations

The presentations for some of the sessions are uploaded at: https://badal.hbcse.tifr.res.in/index.php/s/Z7kr5FodkLXCboN

# Coursework for BESTM Teacher Fellows HBCSE (TIFR)

(June 10 to June 22, 2019)



Engaging with Mathematics activities



Engaging with Design and Technology activities



Exploring Telescope



Exploring concept maps





Reflecting on diversity related to classrooms



Getting introduced to STEM research





Visit to CoESME IISER (Pune)





Visit to Nehru Science Centre (Mumbai)

Annexure A –	Details	about	BESTM	teacher	fellows
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Sr.No.	Name	Gender	State	Teaching levels
1	Rajdeep Kaur	F	Punjab	Secondary (class 7, 9 and 10)
2	Pravin D. Shinde	М	Maharashtra	Secondary( classes 6 to 8)
3	Snehal Choudhary	F	Maharashtra	Higher-secondary (class 11 and 12)
4	Vimal Kumar	М	Kerala	Undergraduate (Physics)
5	Sanjay Sharma	М	Karnataka	Undergraduate (Physics), Teaching B.ScB.Ed. (Physical Sciences)
6	Muhammed Rafeek	М	Kerala	Higher-secondary (class 11 and 12)
7	Sudhir Verma	М	Delhi	Undergraduate (Biology)
8	Mayur B. Gaikwad	М	Maharashtra	Undergraduate (Biology)
9	Sandip Dutta	М	Arunachal Pradesh	Higher-secondary (class 11 and 12)
10	Meenu Rani	F	Punjab	Secondary (class 6 to 10)
11	Vinay Bapu Ramesh	М	Karnataka	Teaching experience Secondary (Class 8 to 12), Currently Research associate with an NGO.
12	Arun Bais	М	Maharashtra	Primary/Secondary (class 1 to 8)
13	Harshada Salunkhe	F	Maharashtra	Secondary (class 8 to 10)
14	Neeta Rani	F	Delhi	Secondary (class 6 to 10)
15	Abhaya Kar	М	Odisha	Primary/Secondary (class 3 to 10)
16	Preeti Nanda	F	Delhi	Primary/Secondary (class 1 to 10)
17	Chhavi Gupta	F	Andhra Pradesh	Primary (class 1 to 5)
18	Kalpana Maski	F	Bhopal	Undergraduate (Physics)
19	William Doyle	М	Puducherry	Secondary/ Higher secondary (class 9 to 12)
20	Sreeja V	F	Karnataka	Secondary (class 5 to 10)
21	Bharath A.J.	М	Karnataka	High School and College
22	Pushpanjali Bhagat	F	New Delhi	18 years of teaching experience. (From Primary to Higher Secondary) Currently pursuing Ph.D in education.
23	Manju Chauhan	F	Delhi	Secondary (class 6-10)
24	Raghvi Gupta	F	Madhya Pradesh	Primary (class 1)
25	Ankita Chaturvedi	F	Madhya Pradesh	Secondary (class 7 and 8)

Sr.No.	Name	Areas for projects	Mentors		
1	Rajdeep Kaur	Development of low-cost science experiments	P. K. Joshi		
2	Pravin D. Shinde	at secondary level			
3	Snehal Choudhary				
4	Vimal Kumar	Student misconceptions, concept inventories and peer learning in physics	Praveen P. Pathak Mashood K.K		
5	Sanjay Sharma				
6	Muhammed Rafeek	Experimental physics education projects	Shirish R. Pathare		
7	Sudhir Verma		Nagarjuna G. Jaikishan Advani		
8	Mayur B. Gaikwad	Developing resources for biology education	M.C. Arunan Meena Kharatmal		
9	Sandip Dutta	Essential experimental techniques of current	Anuttama Kulkarni		
10	Meenu Rani	biology			
11	Vinay Bapu Ramesh	Development of experimental modules for chemistry laboratory	Savita Ladage Ankush Gupta		
12	Arun Bais				
13	Harshada Salunkhe		Aaloka Kanhere		
14	Neeta Rani	Mathematics education	Shweta S. Naik Harita P Raval		
15	Abhaya Kar	-			
16	Preeti Nanda	-			
17	Chhavi Gupta	Design and Technology Education	Adithi Muralidhar Anisha M. Dalvi		
18	Kalpana Maski	Computer simulations and ICT for science and	Surendra Patil		
19	William Doyle	mathematics education	Nagarjuna G		
20	Sreeja V	Tinkering Space	Ashish K. Pardeshi Surendra Patil		
21	Bharath A.J.	Thikening Space	Nagarjuna G.		
22	Pushpanjali Bhagat				
23	Manju Chauhan	School Science Research and Development	Sugra Chunawala Narendra D. Deshmukh		
24	Raghvi Gupta	Project			
25	Ankita Chaturvedi				

Sr.No	Resource persons outside HBCSE	Resource persons from HBCSE
1	Anil Sadgopal	Aaloka Kanhere
2	Disha Nawani	Aniket Sule
3	Eleanor Sayre	Anisha Malhotra Dalvi
4	H. C. Pradhan	Ankush Gupta
5	Jayashree Ramadas	K. Subramaniam
6	Kalpana Kharade	M. C.Arunan
7	Kamal Mahendroo	Mashood K. K.
8	Kamala Mukunda	Meena Kharatmal
9	Kishore Darak	Nagarjuna G.
10	Ruchi Kumar	Narendra D. Deshmukh
11	Sadhana Saxena	P. K. Joshi
12	Srilatha Juvva	Savita Ladage
13	T.V.Venkateshwaran	Shirish R. Pathare
14	-	Shweta Naik
15	-	Sugra Chunawala

### List of resource persons for course work

### **BESTM** Coursework Themes

- 1. Handling student diversity
- 2. Introduction to STME research
- 3. Research based teaching practices
- 4. Research methodology
- 5. Authentic assessment
- 6. Use of technology in education
- 7. Reading and writing scientific documents
- 8. Experimental investigations/mathematical explorations/basic skills of doing science
- 9. Leadership development
- 10. History and nature of science

### Annexure B – BESTM Coursework Time Table

June	Session I		Session II			Sessio	on III			Session	IV		]
(Date)	( 9.30am - 11.00am)		(11.30am to	1.00pm)		(2.00p	pm to 3.30pr	n)		(4.00pm	to 5.30pm)		
9 Sundav													
10 Monday	Introduction to the programme and participants		Theme 2- Introduction to STME research Eleanor Sayre (Helping students learn more)			Ther tech	me 6- Use of nology in	[		Theme 6- Use of technology in education			
	K. Subramaniam				ırn		Nagarjuna G. and			Nagarjuna G. and M.C.Arunan			
		-				(STI	(STEM Habits)			(STEM Habits)			
Tuesday	student diversity	Theme 8- Ex		s/ I					)Tea	teaching practices			
	Sugra Chunawala	(11.00am te	mathematical explorations/ of doing scie	basic skills nce	c skills	Intera	Interactions with mentors		n to 4.00pm	Meena K (Concep	Meena Kharatmal Concept mapping)		
		0am)	Aaloka Kanh (ICT and Ma	ere aths labs)	)pm t				.30pn				
12 Wednesday	Theme 2- Introduction	11.3	Theme 2- Int STME resear	roduction to	(1.00	Them	Theme 8- Experimental		(3	Theme 1 nature of	Theme 10- History and		Dinner with Centre Director (6 30pm)
	to STME research K. Subramaniam		Ruchi Kumar		n	mathe explor	mathematical explorations/ basic skills of doing science Anisha Malhotra Dalvi/ N.D. Deshmukh (Lab sessions- Integrated			Aniket S	Aniket Sule		
	(Understanding students' thinking in science and				An N.I (La					(Astronomy- building telescopes)			
13	mathematics)			Whol	e dav visit	to IISE	FR (Pune)						
Thursday 14	Theme 6- Use of		Theme 5- A	uthentic		(2.00	pm to 3.00pr	n)		(3.30pm	onwards)		
Friday	technology in education		assessment			Them	Theme 1- Handling		Tea (3.00pm to	Theme 10- History and nature of science			
	Jayashree Ramadas		Disha Nawar	i		studer	ent diversity 3.30pm )			Anil Sadgopal			
			(Assessment	)		Kalpa	ana Kharade						
15 Saturday				Theme	9- Leaders	ship De	evelopment						
16 Conden					Sinding	1 50 4 40	Holiday						·
Sunday	Session I			Session II	1.00			Sessio	n III			Sessio	on IV
	(9.30am - 11.00am	)		(11.30am t	o 1.00pm)			(2.00p	m to 3.30pm)			(4.00p	om to 5.30pm)
17 Monday	Theme 1- Handling diversity	student		Theme 5- A assessment	Authentic		Them		e 10- History a of science		Them	e 8- Experimental igations/	
	Kamala Mukunda	Kamala Mukunda		H. C. Prad				Ankus	nkush Gupta		mathe		matical explorations/ skills of doing science
				(Assessment teachers in	nt done by the							Meena	a Kharatmal
18 Tuesday	Theme 4- Research methodology		_	classrooms Interaction	eraction with mentors			Theme	e 7- Reading a g scientific	nd	Them		e 7- Reading and g scientific
	Shweta Naik	Shweta Naik						docum	y N.D.Deshmukh			docun	nents
	(Research methodol	ogy)					]					Led by	y N.D.Deshmukh
19 Theme 10- History Wednesday nature of science		and	E Theme 10- nature of s		)- History and science		unch	(Readi Theme investi	ing Research Papers) e 8- Experimental tigations/		n )Tea	(Read Them STME	ing Research Papers) e 2- Introduction to E research
	Kishore Darak	Kishore Darak (Introduction to the new National Policy on Education)					I(md( b		matical explor skills of doing	ations/ science	nq00.	Masho	ood K. K.
	(Introduction to the National Policy on Education)			S Kamal Ma			om to 2.0	Shirisl	n R. Pathare		Sopm to 4	(Intro resear	duction to STME ch)
20	Theme 10- History	and	(11.0	Theme 10-	History an	ıd	(1.00]	Theme	e 8- Experimer	ntal	(3.	Them	e 8- Experimental
Thursday	nature of science	nature of science Sadhana Saxena		nature of so	nal Mahendroo			investi mathe	investigations/ mathematical explora		itions/		igations/ matical explorations/
	Sadhana Saxena			Kamal Mal				basic skills of doing		science		basic :	skills of doing science
	(Social aspects of S	cience)						Shirish	n R. Pathare			P. K	Joshi
21 Friday	Theme 2- Introduction to Presentat STME research by participation Savita Ladage		Presentatio by participa	tions Pres cipants by p			Presen by par	tations ticipants	Intera projec Srilat		ctions about the ts na Juvva		
	(Introduction to STI research)	ME											
22					τ.7	init t - 1	Nohm 9-1-						
Saturday					V	isit to I	iveniu Sciene	ce Centr	c				