

## Sahana Murthy

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Inter-Disciplinary Program in Educational Technology

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### Education

<b>Ph.D.</b> , Physics. Rutgers University.	May 2004
<b>M.Sc.</b> , Physics. Indian Institute of Technology Bombay.	June 1997
<b>B.Sc.</b> , Physics. University of Mumbai.	June 1995

### Professional Experience

*Professor*, Educational Technology, IIT Bombay, July 2019 - date.

*Associate Professor*, Educational Technology, IIT Bombay, 2014 - 2019.

*Assistant Professor*, Educational Technology, IIT Bombay, 2009 - 2014.

*Lecturer*, Experimental Study Group, Massachusetts Institute of Technology, 2006-9.

*Post-doctoral Research Associate*, Center for Educational Computing Initiatives (TEAL project),  
Massachusetts Institute of Technology, 2005-6.

*Post-doctoral Research Associate*, Physics Education Research group, Rutgers University, 2004-5.

### Ph. D students

8 graduated (6 as guide, 2 as co-guide); 4 ongoing (1 each in 5<sup>th</sup>, 4<sup>th</sup>, 3<sup>rd</sup>, 2<sup>nd</sup> year)

### Post docs

1 Institute post-doc (2016-17); 2 post-docs (current)

### Teaching

*IIT Bombay:*

Introduction to educational technology (MTech & PhD core course) 2010-19

Research methods in educational technology (PhD core course) 2011-18

Instructional systems design (PG elective) 2020

Design of learning environments (PG elective) 2020

Electricity and magnetism (1<sup>st</sup> year core course) 2010

*MIT (2005-9)*, in Experimental Study Group program:

Mechanics (Physics 1<sup>st</sup> year course)

Electricity and magnetism (Physics 1<sup>st</sup> year course)

How learning changes the brain (Project-based course)

### Awards

2020 Prof S P Sukhatme Excellence in Teaching Award, IIT Bombay

2019 Robert De Kieffer International Fellowship Award, awarded by Association of Educational Communications & Technology (AECT)

2019 Reviewer Excellence Award, ETR&D journal

## Publications

### Peer-reviewed journals

1. Geneticus Investigatio: A Technology-Enhanced Learning Environment for Scaffolding Complex Learning in Genetics. Anurag Deep, Sahana Murthy, and Jayadeva Bhat. *Research and Practice in Technology Enhanced Learning*, 15:24, 2020.
2. Mechanism to capture learner's interaction in VR-based learning environment: design and application. Rumana Pathan, Ramkumar Rajendran and Sahana Murthy. *Smart Learning Environments*, 7:35, 2020.
3. IDC theory: Habit and the habit loop. W. Chen, T-W.Chan, L. H. Wong, C.-K. Looi, C. C. Y. Liao, H. N. H. Cheng, S. L. Wong, J. Mason, H.-J. So, S. Murthy, X. Gu and Z. Pi. *Research and Practice in Technology Enhanced Learning*, 15:10. (2020)
4. Is this Solution Pink Enough? A Smartphone Tutor to Resolve the Eternal Question in a Phenolphthalein-based Titration. Balraj Rathod, Sahana Murthy and Subhajit Bandyopadhyay. *Journal of Chemical Education*, 96(3), February 2019.
5. MEttLE: A Modelling-based Learning Environment for Undergraduate Engineering Estimation Problem Solving. Aditi Kothiyal and Sahana Murthy. *Research and Practice in Technology Enhanced Learning*, November 2018.
6. Interest-driven creator theory: towards a theory of learning design for Asia in the twenty-first century. Tak-Wai Chan, Chee-Kit Looi, Wenli Chen, Lung-Hsiang Wong, Ben Chang, Calvin C. Y. Liao, Hercy Cheng, Zhi-Hong Chen, Chen-Chung Liu, Siu-Cheung Kong, Heisawn Jeong, Jon Mason, Hyo-Jeong So, Sahana Murthy, Fu-Yun Yu, Su Luan Wong, Ronnel B. King, Xiaoqing Gu, Minhong Wang, Longkai Wu, Ronghuai Huang, Rachel Lam, Hiroaki Ogata. *Accepted in Journal of Computers in Education*, 1-27. September 2018.
7. Personalized affective feedback to address students' frustration in ITS. Ramkumar Rajendran, Sridhar Iyer, Sahana Murthy. *IEEE Transactions on Learning Technologies*, 2018.
8. CuVIS: An interactive tool for instructors to create effective customized learning designs with visualizations. Gargi Banerjee and Sahana Murthy. *Australasian Journal of Educational Technology*, 34(2), 2018. doi:<https://doi.org/10.14742/ajet.3773>
9. MIC-O-MAP: A technology enhanced learning environment for developing micro-macro thinking skills. Anura Kenkre and Sahana Murthy. *Research and Practice in Technology Enhanced Learning*, 12(1), 23, 2017.
10. Designing Reciprocal Dynamic Linking to improve learners' Representational Competence in interactive learning environments. Mrinal Patwardhan and Sahana Murthy. *Research and Practice in Technology Enhanced Learning*, 12:10, 2017.
11. ET4ET: A large-scale professional development program on effective integration of educational technology for engineering faculty. Sahana Murthy, Sridhar Iyer and Jayakrishnan Warriem. *Educational Technology & Society*, vol. 18(3), pp. 16-28, 2015.
12. Effect of active learning using program visualization in technology constrained college classrooms. Gargi Banerjee, Sahana Murthy and Sridhar Iyer. *Research and Practice in Technology Enhanced Learning*, vol. 10(1), pp. 1-25, 2015.
13. When does higher degree of interaction lead to higher learning in visualizations? Exploring the role of 'Interactivity Enriching Features'. Mrinal Patwardhan and Sahana Murthy. *Computers & Education*, vol. 82, pp. 292-305, 2015.
14. A theory-driven approach to predict frustration in an ITS. Ramkumar Rajendran, Sridhar Iyer,

- Sahana Murthy, Campbell Wilson and Judithe Sheard. *IEEE Transactions on Learning Technologies*, **6** (4), pp. 378-388, 2013.
15. Design based research to create instructional design templates for learning objects. Sameer Sahasrabudhe, Sahana Murthy and Sridhar Iyer. *New Frontiers in Education*, vol.46(1), pp.27-46, 2013.
  16. Applying traditional animation principles for creating learning objects. Sameer Sahasrabudhe, Sahana Murthy and Sridhar Iyer. *New Frontiers in Education*, vol.45(2), pp.81-99, 2012.
  17. Design and evaluation of OSCAR physics learning objects. A. Kenkre and S. Murthy. *Journal of Research: The Bede Athenaeum* 3 (1), 6-10, 2012.
  18. Using action research to improve learning and formative assessment to conduct research. E. Etkina, A. Karelina, S. Murthy and M. Ruibal-Villasenor. *Physical Review Special Topics, Physics Education Research*, **5**, 010109, 2009.
  19. Scientific abilities and their assessment. E. Etkina, A. Van Heuvelen, S. White-Brahmia, D. Brookes, M. Gentile, S. Murthy, D. Rosengrant, and A. Warren. *Physical Review Special Topics, Physics Education Research*, **2**, 020103, 2006.
  20. Using introductory labs to engage students in experimental design. Eugenia Etkina, Sahana Murthy and Xueli Zou. *American Journal of Physics*, **74**, 979, 2006.
  21. Compressibility divergence and the finite temperature Mott transition. G. Kotliar, S. Murthy and M. J. Rozenberg. *Physical Review Letters*, **89**, 046401, 2002.
  22. Haldane Gap in S=2 XXZ quantum anti-ferromagnet. C. Y. Kadohkar, N. Goveas, D. K. Ghosh and S. Murthy. *Journal of magnetism and magnetic materials*, **177-181**, Part 1, 638, 1998.

#### *Invited*

1. Physics Education Research in the Laboratory Setting. Sahana Murthy. *Physics News: Bulletin of Indian Physics Association, Special Issue on Physics Education Research*. Guest Editor Arvind Kumar. No. 4, Vol. 41, 20-32, October 2011.

#### *Book Chapters*

1. S. Murthy, J. M. Warriem and S. Iyer. Technology Integration for Student-Centered Learning: A Model for Teacher Professional Development Programs. In "*Emerging Practices in Scholarship of Learning and Teaching in a Digital Era*", Eds. S.C. Kong, T. L. Wong, M. Yang, C. F. Chow, and K. H. Tse. Singapore, Springer, 2017.
2. S. Murthy, S. Iyer, and M. Mavinkurve. Pedagogical framework for developing thinking skills using smart learning environments. In "*Learning, Design and Technology - An international compendium of theory, research, practice and policy*". Eds. J. M. Spector, B. Lockee and M. D. Childress. Switzerland, Springer International Publishing, 2016.

#### *International peer-reviewed conference proceedings*

1. Disciplinary model-based reasoning and metacognition underlies good estimation performance by engineering undergraduates. Aditi Kothiyal and Sahana Murthy. 14<sup>th</sup> International Conference of the Learning Sciences (ICLS 2020) Vol 2 (pp. 1095-1102). Nashville, TN, USA.
2. Flare-Fork: A pedagogy for expanding problem and solution space for design problem solving. Soumya Narayanan and Sahana Murthy. In 27<sup>th</sup> International Conference on Computers in Education, (ICCE 2019), Taiwan. December 2-6, 2019.

3. *Geneticus Investigatio*: A classroom-based technology-enhanced learning environment for problem-solving process skills in genetics. Anurag Deep and Sahana Murthy. In 27<sup>th</sup> International Conference on Computers in Education, (ICCE 2019), Taiwan. Dec. 2-6, 2019.
4. RoadEthos: Game based learning to sensitize children on road safety through ethical reasoning. Herold P.C., Ulfa Khwaja, Chandan Dasgupta and Sahana Murthy. In 10<sup>th</sup> IEEE International Conference on Technology for Education (T4E 2019) Goa, India, Dec. 9-11, 2019.
5. MathReality: A bridge from concrete to abstract via an AR app for concept of exponents. Herold P C, Chandan Dasgupta, Sahana Murthy and Anirudha Joshi. IEEE 19<sup>th</sup> International Conference on Advanced Learning Technologies (ICALT 2019), Maceo, Brazil, India. July 15-18, 2019.
6. LCM: A model for planning, designing and conducting Learner-Centric MOOCs. Sahana Murthy, Jayakrishnan Warriem, Sameer Sahasrabudhe and Sridhar Iyer. 9th IEEE International Conference on Technology for Education (T4E 2018) Chennai, India, December 10-13, 2018.
7. Learner-centric MOOC for teachers on effective ICT integration: Perceptions and experiences. Veenita Shah, Gargi Banerjee, Sahana Murthy and Sridhar Iyer. 9th IEEE International Conference on Technology for Education (T4E 2018) Chennai, India, December 10-13, 2018.
8. GeSolvAR: Augmented reality based application for mental rotation. Navneet Kaur, Rumana Pathan, Ulfa Khwaja, Pratiti Sarkar, Balraj Rathod and Sahana Murthy. 9th IEEE International Conference on Technology for Education (T4E 2018) Chennai, India, December 10-13, 2018.
9. StereoChem: Augmented reality 3D molecular model visualization app for teaching and learning of stereochemistry. K. L. N. Swamy, P. Chavan and S. Murthy. IEEE 18<sup>th</sup> International Conference on Advanced Learning Technologies (ICALT 2018), Mumbai, India. July 9-13, 2018.
10. GeoSolvAR: Augmented reality based solution for visualizing 3D solids. Navneet Kaur, Rumana Pathan, Ulfa Khwaja and Sahana Murthy. IEEE 18<sup>th</sup> International Conference on Advanced Learning Technologies (ICALT 2018), Mumbai, India. July 9-13, 2018.
11. Exploring How Students Learn Estimation Using a Modelling-based Learning Environment. Aditi Kothiyal and Sahana Murthy. 13<sup>th</sup> International Conference of the Learning Sciences (ICLS 2018), London, UK. June 23-27, 2018.
12. Flipped Classroom Strategy to Help Underachievers in Java Programming. Manoj Kumar P., Renumol V.G. and Sahana Murthy. 6<sup>th</sup> International Conference on Learning and Teaching in Computing and Engineering (LaTiCE 2018), Auckland, New Zealand. April 20-22, 2018.
13. Examining Student Learning of Engineering Estimation from METTLE. Aditi Kothiyal and Sahana Murthy. 25<sup>th</sup> International Conference on Computers in Education, (ICCE 2017), Christchurch, New Zealand. December 4-8, 2017.
14. PIVOTeeING: A Flipped Approach in a Postgraduate Solid State Devices Course. Lakshmi T G, Soumya Narayana, Harshavardhan Penugonda, Dharendra Vaidya, Vishvendra Poonia, Swaroop Ganguly and Sahana Murthy. 25<sup>th</sup> International Conference on Computers in Education, (ICCE 2017), Christchurch, New Zealand. December 4-8, 2017.
15. Transfer of Ownership: Designing for Scholarship of Learning and Teaching. Warriem, J., Murthy, S. & Iyer, S. 6th Workshop on ICT Trends in Emerging Economies in the 25th International Conference on Computers in Education (ICCE2017) Christchurch, New Zealand. Dec. 4-8, 2017.

16. Learning of Micro-Macro Thinking in Analog Electronics via MIC-O-MAP TEL Environment. Anura Kenkre and Sahana Murthy. IEEE 17<sup>th</sup> International Conference on Advanced Learning Technologies (ICALT 2017), Timisoara, Romania, July 3-7, 2017.
17. CoMBaT: Wearable Technology Based Training System for Novice Badminton Players. Ashutosh Raina, Lakshmi Ganesh and Sahana Murthy. IEEE 17<sup>th</sup> International Conference on Advanced Learning Technologies (ICALT 2017), Timisoara, Romania, July 3-7, 2017.
18. Geometry via Gestures: Learning 3D geometry using gestures. Soumya Narayana, Prajish Prasad, Lakshmi T.G. and Sahana Murthy. Proceedings of the 8<sup>th</sup> IEEE International Conference on Technology for Education (T4E 2016) Mumbai, India, December 2-4, 2016.
19. Shifting focus from learner completion to learner perseverance: Evidence from a teacher professional development MOOC. J. Warriem, S. Murthy and S. Iyer. 24<sup>th</sup> International Conference on Computers in Education, (ICCE 2016), Mumbai, India. Nov 28- Dec 2, 2016.
20. Geneticus investigatio: An agent-based modeling system for teaching-learning hypothetico-deductive reasoning in Mendelian genetics. Anurag Deep, Sahana Murthy and P. Jayadeva Bhat. Proceedings of the 8<sup>th</sup> IEEE International Conference on Technology for Education (T4E 2016) Mumbai, India, December 2-4, 2016.
21. Student learning paths in developing micro-macro thinking: Productive actions for exploration in MIC-O-MAP learning environment. Anura Kenkre and Sahana Murthy. 24<sup>th</sup> International Conference on Computers in Education (ICCE 2016), Mumbai, India. Nov 28- Dec 2, 2016.
22. Geometry via Gestures: Design of a gesture based application to teach 3D geometry. Lakshmi T.G., Prajish Prasad, Soumya Narayana, Sahana Murthy and Sanjay Chandrasekharan. In Proceedings of Workshop on Emerging Pedagogies for Computer-Based Learning in the International Conference on Computers in Education (ICCE 2016), Mumbai, India, 2016.
23. Game Based Learning of Blood Clotting Concepts. Anurag Deep, Prajish Prasad, Soumya Narayana, Maiga Chang, Sahana Murthy. IEEE 16<sup>th</sup> International Conference on Advanced Learning Technologies (ICALT 2016), Austin, Texas, USA. July 25-28, 2016.
24. Hearts pump and hearts beat’’: Engineering estimation as a form of model-based reasoning. Aditi Kothiyal, Sahana Murthy and Sanjay Chandrasekharan. 12<sup>th</sup> International Conference of the Learning Sciences (ICLS 2016), Singapore. June 20-24, 2016.
25. Designing a technology enhanced learning environment for hypothetico-deductive reasoning in genetics. Anurag Deep, Sahana Murthy and P. J. Bhat. 6<sup>th</sup> International conference on Science, Technology and Mathematics Education (epiSTEME 6), Mumbai, India, Dec. 15-18, 2015.
26. From novice to expert instructional designer: A training based on cognitive apprenticeship model. Vasanta Akondy and Sahana Murthy. 7<sup>th</sup> IEEE International Conference on Technology for Education (T4E 2015), Warangal, India, December 10-12, 2015.
27. How reciprocative dynamic linking supports learners' representational competence: An exploratory study. Mrinal Patwardhan and Sahana Murthy. 23<sup>rd</sup> International Conference on Computers in Education, (ICCE 2015), Hangzhou, China. November 30- December 4, 2015.
28. Sustainability at scale: Evidence from a large scale teacher professional development program. Jayakrishnan Warriem, Sahana Murthy and Sridhar Iyer. 23<sup>rd</sup> International Conference on Computers in Education, (ICCE 2015), Hangzhou, China. November 30- December 4, 2015.
29. CuVIS tool to develop instructors' competency in creating meaningful learning designs. Gargi Banerjee and Sahana Murthy. 23<sup>rd</sup> International Conference on Computers in Education, (ICCE 2015), Hangzhou, China. November 30- December 4, 2015.

30. Exploring student difficulties in divide and conquer skill with a mapping tool. Aditi Kothiyal and Sahana Murthy. Workshop on Technology Enhanced Learning on Thinking Skills (TELoTS), at the 23<sup>rd</sup> International Conference on Computers in Education, (ICCE 2015), Hangzhou, China. November 30- December 4, 2015.
31. Design of TEL environment to develop Multiple Representation thinking skill. Madhuri Mavinkurve and Sahana Murthy. Workshop on Technology Enhanced Learning on Thinking Skills (TELoTS), at the 23<sup>rd</sup> International Conference on Computers in Education, (ICCE 2015), Hangzhou, China. November 30- December 4, 2015.
32. Development of engineering design competencies using TELE-EDesC: Do the competencies transfer? Madhuri Mavinkurve and Sahana Murthy. IEEE 15<sup>th</sup> International Conference on Advanced Learning Technologies (ICALT 2015), Hualein, Taiwan, July 7-9, 2015.
33. Delayed Guidance: A teaching-learning strategy to develop ill-structured problem solving skills in engineering. Aditi Kothiyal, Bipin Rajendran and Sahana Murthy. 3<sup>rd</sup> International Conference on Learning and Teaching in Computing and Engineering (LaTiCE 2015), Taipei, Taiwan. April 9-12, 2015.
34. Thinking, pairing, and sharing to improve learning and engagement in a Data Structures and Algorithms (DSA) class. Deepti Reddy, Shitanshu Mishra, Ganesh Ramakrishnan and Sahana Murthy. 3<sup>rd</sup> International Conference on Learning and Teaching in Computing and Engineering (LaTiCE 2015), Taipei, Taiwan. April 9-12, 2015.
35. A self-study learning environment for modeling abilities: Do all learners take the same learning path? Anura Kenkre and Sahana Murthy. Proceedings of the 6<sup>th</sup> IEEE International Conference on Technology for Education (T4E 2014) Kollam, India, December 18-21, 2014.
36. Guided Problem Solving and Group Programming: A technology-enhanced teaching-learning strategy for engineering problem solving. Abhinav Anand, Aditi Kothiyal, Bipin Rajendran and Sahana Murthy. Proceedings of the 6<sup>th</sup> IEEE International Conference on Technology for Education (T4E 2014) Kollam, India, December 18-21, 2014.
37. The enactive equation: Exploring how multiple external representations are integrated, using a fully controllable interface and eye-tracking. Rwitajit Majumdar, Aditi Kothiyal, Prajakt Pande, Harshit Agarwal, Ajith Ranka, Sahana Murthy and Sanjay Chandrasekharan. Proceedings of the 6<sup>th</sup> IEEE International Conference on Technology for Education (T4E 2014) Kollam, India, December 18-21, 2014.
38. Learning design framework for constructive strategic alignment with computer-based visualizations. Gargi Banerjee, Mrinal Patwardhan and Sahana Murthy. 22<sup>nd</sup> International Conference on Computers in Education, (ICCE 2014), Nara, Japan. Nov. 30- Dec. 4, 2014.
39. A2I: A model for teacher training in constructive alignment for use of ict in engineering education. Jayakrishnan M. Warriem, Sahana Murthy and Sridhar Iyer. 22<sup>nd</sup> International Conference on Computers in Education, (ICCE 2014), Nara, Japan. Nov. 30- Dec. 4, 2014.
40. Development of predict-test-revise modeling abilities via a self-study learning environment. Anura Kenkre, Sahana Murthy and Madhuri Mavinkurve. 22<sup>nd</sup> International Conference on Computers in Education, (ICCE 2014), Nara, Japan. Nov. 30- Dec. 4, 2014.
41. Self-assessment rubrics as metacognitive scaffolds to improve design thinking. Madhuri Mavinkurve and Sahana Murthy. Workshop on Technology Enhanced Learning of Thinking Skills, in 22<sup>nd</sup> International Conference on Computers in Education (ICCE 2014). Japan: Asia-Pacific Society for Computers in Education. Nara, Japan. Nov. 30- Dec. 4, 2014.

42. Customized Selection and Integration of Visualization Tool for Instructors. Gargi Banerjee, Anura Kenkre, Madhuri Mavinkurve and Sahana Murthy. IEEE 14th International Conference on Advanced Learning Technologies (ICALT 2014), Athens, Greece, July 7-10, 2014.
43. Think-Pair-Share in a large CS1 class: Does learning really happen? Aditi Kothiyal, Sahana Murthy and Sridhar Iyer. 19<sup>th</sup> Annual ACM conference on Innovation and Technology in Computer Science Education (ITiCSE 2014), Uppsala, Sweden, June 23-25, 2014.
44. Effect of a 2-week Scratch Intervention in CS1 on learners with varying prior knowledge. Shitanshu Mishra, Sridhar Iyer and Sahana Murthy. 19<sup>th</sup> Annual ACM SIGCSE conference on Innovation and Technology in Computer Science Education (ITiCSE 2014), Uppsala, Sweden, June 23-25, 2014.
45. Training in-service teachers to do action research in educational technology. Jayakrishnan M. Warriem, Sahana Murthy and Sridhar Iyer. 5th IEEE International Conference on Technology for Education (T4E 2013) Kharagpur, India, December 18-20, 2013.
46. Guidelines and Templates for Planning, Conducting and Reporting Educational Technology Research (Tutorial). Sahana Murthy and Sridhar Iyer. IEEE International Conference on Technology for Education (T4E 2013) Kharagpur, India, December 18-20, 2013.
47. Comparing self-learning behavior of low and high scorers in computer based visualization for engineering design competencies. Madhuri Mavinkurve and Sahana Murthy. 21st International Conference on Computers in Education, (ICCE 2013), Bali, Indonesia. November 18-22, 2013.
48. Program visualization: Effect of viewing vs. responding on student learning. Gargi Banerjee, Sahana Murthy and Sridhar Iyer. 21st International Conference on Computers in Education, (ICCE 2013), Bali, Indonesia. November 18-22, 2013.
49. A model for active learning in synchronous remote classrooms: Evidence from a large-scale implementation. Jayakrishnan M. Warriem, Sahana Murthy and Sridhar Iyer. In 21st International Conference on Computers in Education, (ICCE 2013), Bali, Indonesia. November 18-22, 2013.
50. Effect of Think-Pair-Share in a large CS1 class: 83% sustained engagement. A. Kothiyal, R. Majumdar, S. Murthy and S. Iyer. ACM Ninth International Computing Education Research Workshop, (ICER 2013), San Diego, USA, August 12-14, 2013.
51. Demystifying networking: teaching non-majors via analogical problem-solving. Sridhar Iyer and Sahana Murthy. ACM Symposium on Computer Science Education (SIGCSE 2013), Denver, USA, March 2013.
52. Embedding visual communication principles in Instructional Design phase of Learning Object creation process. Sameer Sahasrabudhe, Sahana Murthy and Sridhar Iyer. World Conference on Education and Multimedia (ED-MEDIA 2012), Denver, USA, March 2012.
53. Interactive visualizations to teach design skills. M. Mavinkurve and S. Murthy. Workshop on Computer-Supported Visualization, Modeling, and Simulation for Learning in the 20<sup>th</sup> International Conference on Computers in Education (ICCE 2012), Singapore, Nov 26-30, 2012.
54. Effect of instructors' pedagogy and TPACK on integration of computer based visualizations. G. Banerjee and S. Murthy. Workshop on Computer-Supported Visualization, Modeling, and Simulation for Learning in the 20th International Conference on Computers in Education (ICCE 2012), Singapore, Nov 26-30, 2012.
55. Identifying Learning Object Pedagogical Features to Decide Instructional Setting. A. Kenkre,

- G. Banerjee, M. Mavinkurve and S. Murthy. Proceedings of the 4th IEEE International Conference on Technology for Education (T4E 2012), Hyderabad, India, July 18-20, 2012.
56. Pedagogical Analysis of Content Authoring Tools for Engineering Curriculum. A. Diwakar, M. Patwardhan and S. Murthy. Proceedings of the 4th IEEE International Conference on Technology for Education (T4E 2012), Hyderabad, India, July 18-20, 2012.
57. Literature Driven Method for Modeling Frustration in an ITS. Ramkumar Rajendran, Sridhar Iyer and Sahana Murthy IEEE 12th International Conference on Advanced Learning Technologies (ICALT), Rome, Italy, July 4-6, 2012.
58. Teaching-learning with interactive visualization: How to choose the appropriate level? Mrinal Patwardhan and Sahana Murthy. IEEE International Conference on Technology Enhanced Education (ICTEE 2012), Amritapuri, India, January 3-5, 2012.
59. Visualisation to enhance students' engineering design ability. Madhuri Mavinkurve and Sahana Murthy. IEEE International Conference on Technology Enhanced Education (ICTEE 2012), Amritapuri, India, January 3-5, 2012.
60. Model for large scale development of learning objects. Gargi Banerjee and Sahana Murthy. Proceedings of the 3rd IEEE International Conference on Technology for Education (T4E 2011), Chennai, India. July 14-16, 2011.
61. Probing students' affective domain in an ICT-enriched course. Madhulika Goyal and Sahana Murthy. epiSTEME-4, Homi Bhabha Centre for Science Education, Mumbai, January 2011.
62. Raising students' cognitive levels, extending level of textbook questions: Can we do both? Usha Viswanathan and Sahana Murthy. Proceedings of epiSTEME-4, Homi Bhabha Centre for Science Education, Mumbai, January 2011.
63. Using System Dynamics to Model and Analyze a Distance Education Program. Sahana Murthy, Rohit Gujrati and Sridhar Iyer. International Conference on Information and Communication Technologies and Development (ICTD) 2010, London, UK. December 2010.
64. Clicking away the distance from education. Divya Tiwari, Richa Sehgal, Jayant Bansal and Sahana Murthy. 2nd IEEE International Conference on Technology for Education (T4E 2010), Mumbai, July 2010.
65. Student perceptions in the use of new technologies in engineering courses. M Goyal and S. Murthy. International Workshop on Technology for Education (T4E 2009), Bangalore, August 2009.
66. Peer-assessment of homework using rubrics. Sahana Murthy. AIP 2007 Physics Education Research Conference, Greensboro, NC. July 2007.
67. Developing and assessing student scientific abilities. Eugenia Etkina, David T Brookes, Sahana Murthy, Anna Karelina, Maria Ruibal Villasehor, Alan Van Heuvelen. STEM Assessment Conference, October 2006.
68. Taking First Steps to Understand Transfer of Scientific Abilities. Eugenia Etkina and Sahana Murthy. National Association of Research in Science Teaching, Conference Proceedings (NARST), San Francisco, CA. April 2006.
69. Design labs: student expectations and reality. Eugenia Etkina and Sahana Murthy. AIP 2005 Physics Education Research Conference, Salt Lake City, UT. August 2006.
70. Using experimental design problems to help students in a large enrollment class develop scientific abilities. Sahana Murthy and Eugenia Etkina. National Association of Research in Science Teaching, Conference Proceedings (NARST), Dallas, TX. August 2005.



71. Development of scientific abilities in a large class. Sahana Murthy and Eugenia Etkina. AIP 2004 Physics Education Research Conference, Sacramento, CA. August 2004.

#### *Specifications and Technical Reports*

1. Sahana Murthy and Sridhar Iyer. Guidelines and Templates for Planning, Conducting and Reporting Educational Technology Research. Technical Report (*TR-ET-2013-01*), Inter-Disciplinary Program in Educational Technology, IIT Bombay, Dec 2013.
2. Sridhar Iyer, Farida Khan, Sahana Murthy, Vijayalakshmi Chitta, Malathy Baru and Usha Vishwanathan. CMC: A Model Computer Science Curriculum for K-12 Schools. Technical Report (*TR-CSE-2013-52*), Dept of Computer Science and Engg., IIT Bombay, June 2013.

#### *Editor of conference proceedings*

1. Viraj Kumar, Sahana Murthy, Kinshuk and Sridhar Iyer. Proceedings of the IEEE 9th International Conference on Technology for Education (T4E 2018), Chennai, 2018. (indexed in IEEE Xplore)
2. Maiga Chang, Nian-Shing Chen, Ronghuai Huang, Kinshuk, Kannan Moudgalya, Sahana Murthy and Demetrios G Sampson. Proceedings the 18<sup>th</sup> IEEE International Conference on Advanced Learning Technologies (ICALT 2018), Mumbai, India. (indexed in IEEE Xplore)
3. Weiqin Chen, Jie-Chi Yang, Sahana Murthy, Su Luan Wong and Sridhar Iyer. Proceedings of ICCE 2016, the 24<sup>th</sup> International Conference on Computers in Education, India: Asia-Pacific Society for Computers in Education. 2016.
4. Viraj Kumar, Sahana Murthy and Kinshuk. Proceedings of the IEEE 8th International Conference on Technology for Education (T4E 2016), Mumbai, 2016. (indexed in IEEE Xplore).
5. S. Chandrasekharan, S. Murthy, G. Banerjee and A. Muralidhar (eds.). epiSTEME 6 International Conference to Review Research on Science, Technology and Mathematics Education, Conference Proceedings. India: Cinnamontea. 2015.
6. Sahana Murthy and Kinshuk. Proceedings of the IEEE 6th international conference on Technology for Education, T4E 2014, Amritapuri, 2014. (indexed in IEEE Xplore)
7. Sahana Murthy and Demetrios Sampson. Proceedings of the IEEE 4th international conference on Technology for Education, Hyderabad, 2012. (indexed in IEEE Xplore)
8. Kinshuk and Sahana Murthy. Proceedings of the IEEE 2nd international conference on Technology for Education, Mumbai, 2010. (indexed in IEEE Xplore)

#### **Workshops, Continuing Education Program courses, MOOCs**

- ‘Online Teaching’, self-paced course for instructors to transition to online instruction. *Jointly with Sridhar Iyer, Ashutosh Raina, Lucian Ngeze.* May 2020.
- Instructional design for active learning in blended environments. 5-day in-house CEP course for members of faculty at RBI training institutes, March 4-31, 2020.
- Emerging Technologies for Effective Teaching and Learning. 3-day in-house CEP course for school principals. Instructor. 2 offerings - September 19-21, 2019 and January 9-11, 2020.
- GIAN 5-day course on Learning Sciences: Theories, Concepts and Environments (approved, to be rescheduled due to the pandemic)

- NPTEL course: Designing learner-centric e-learning in STEM. July - September 2019 and 2020.
- NPTEL course: Designing Learner-Centric MOOCs. January-March 2019. *Jointly with Sridhar Iyer, Sameer Sahasrabudhe, Jayakrishnan Warriem.*
- IITBombayX MOOCs: Elements of Learner-Centric MOOCs and Designing Learner-Centric MOOCs. March-Sept 2018. *Jointly with Sridhar Iyer, Sameer Sahasrabudhe, Jayakrishnan Warriem.*
- TEQIP Faculty Induction Workshop at IIT Bombay. Instructor for 3 lectures on learning objectives, assessment and active learning pedagogical strategies, repeated 4 times. January-February 2018.
- TEQIP Senior Faculty Induction Workshop. Instructor for 4 lectures, June 2018.
- Pandit Madan Mohan Malviya National Mission on Teacher Training (PMMMNTT), Faculty induction program at IIT Bombay. Instructor for 2 lectures. December 2017.
- Pedagogy training for student-centered teaching-learning. 2-day in-house CEP course. REC Bijnor. November 9-10, 2017. *Jointly with Sridhar Iyer, Yogendra Pal, Anurag Deep.*
- Pedagogy for effective use of ICT for school teachers. 4-week MOOC on IITBombayX for school teachers and e-learning curriculum designers. Apr-May 2017, Enrolment 11478 and Sep-Oct 2017, Enrolment 2707. *Jointly with Sridhar Iyer, Sameer Sahasrabudhe, Gargi Banerjee.*
- Effective teaching-learning of CS in schools. 4-week MOOC on IITBombayX for school teachers. May-Jun 2017, enrolment 573, and Nov-Dec 2017 enrolment 1642. *Jointly with Sridhar Iyer.*
- Effective designing of Outcome Based Education (OBE) for meaningful learning in engineering education. 2-day in-house CEP course. October 21-22, 2017. *Jointly with Sridhar Iyer, Madhuri Mavinkurve, Gargi Banerjee.*
- Pedagogy for online and blended teaching-learning process FDP101x & FDP201x. Faculty development program under IITBombayX. Co-instructor for multiple offerings in 2017-18.
- Moving from teacher-centric to student-centric teaching. Workshops for school principals, Next Education. September – November 2016.
- Active learning strategies for student learning and engagement. Talk at Refresher course in Mathematical Physics, University of Mumbai. October 18, 2016.
- Strategies for developing effective e-learning content. In-house CEP course (2 days) for Next Education India Pvt Ltd. September 2-3, 2016.
- Educational Technology for Engineering Teachers. 8-week MOOC on IITBx platform, January 7 – March 7, 2016. (5000+ participants). *Jointly with Jayakrishnan Warriem and Sridhar Iyer.*
- Effective Teaching-Learning using Visualizations at the 7<sup>th</sup> IEEE International Conference on Technology for Education T4E2015, Warangal. December 9, 2015. *Jointly with Sridhar Iyer*
- 2<sup>nd</sup> Workshop on ‘Technology enhanced learning of thinking skills’, at the International Conference on Computers in Education, ICCE 2015, Hangzhou, China. Nov. 30, 2015. *Jointly with Madhuri Mavinkurve and Sridhar Iyer.*
- MEET Workshop – Mentoring educators in educational technology, IIT Bombay. Oct 23-25, 2015. *Jointly with Jayakrishnan Warriem, Rwitajit Majumdar and Sridhar Iyer*

- Planning, Conducting and Reporting Educational Technology Research – half-day invited workshop in University of Goa. October 11, 2015.
- Creating your elevator pitch. Session in T10KT workshop on Technical Communication for Scientists and Engineers, IIT Bombay. August 2015.
- Pedagogy for effective use of educational technology in engineering education. 1-week TEQIP workshop, IIT Bombay. Jan. 5-9, 2015. *Jointly with Jayakrishnan Warriem and Sridhar Iyer.*
- Pedagogy for effective use of educational technology in engineering education. 2-week equivalent workshop under Teach 10000 Teachers project, January 5-31, 2015. (4700 participants). *Jointly with Jayakrishnan Warriem and Sridhar Iyer.*
- How to get your paper accepted for T4E2015. Tutorial at the IEEE International Conference in Technology for Education, T4E 2014, Amrita University, Kerala. December 21, 2014. *Jointly with Sridhar Iyer.*
- Technology enhanced learning of thinking skills. Workshop at the International Conference on Computers in Education, ICCE 2014, Nara, Japan, Nov. 30- Dec. 3, 2014. *Jointly with Mrinal Patwardhan and Sridhar Iyer.*
- Pedagogy for effective use of educational technology in engineering education. 2-week equivalent workshop, Quality Enhancement in Engineering Education June-July 2014. (3400 participants). *Jointly with Jayakrishnan Warriem and Sridhar Iyer.*
- Peer-Instruction: An interactive learning strategy. How to promote student conceptual understanding in your course. IDP-ET workshop series. February 27, 2014.
- Conducting ET research in your classroom or lab. Half-day interactive e-workshop, FISAT, Kerala. February 8, 2014. *Jointly with Jayakrishnan Warriem.*
- Effective teaching-learning strategies from Physics Education Research. 2 sessions in UGC Refresher course for B.Sc physics instructors. Mumbai University. Nov. 13-14, 2013.
- Effective Teaching and Learning: How can Educational Technology help? 2 sessions. In-house CEP course for Babasaheb Ambedkar Technological University. Sept. 4, 2013.
- Effective Teaching-Learning Strategies for Quality Engineering Education. Co-instructor for 1 week QIP course for engineering college instructors. June 24-28, 2013. *Jointly with Sridhar Iyer, Madhuri Mavinkurve, Mrinal Patwardhan, Rekha Ramesh and Anita Diwakar.*
- Effective Teaching and Assessment: How can Educational Technology help? 2 sessions. In-house CEP course for Institute of Chemical Technology, Mumbai. Feb. 4, 2013.
- Research in educational technology. 1 week T10KT workshop, February 2-9 2013. 4000+ participants. *Jointly with Sridhar Iyer*
- Effective Teaching and Assessment. 1-day CEP course for NMIMS, Mumbai. March 15, 2012.
- Writing effective conference papers. Instructor for 2-day T10KT course. February 18-19, 2012.
- Instructional design workshop for learning objects. Organized as part of Project OSCAR. IIT Bombay. May 2, 2011. *Jointly with Sameer Sahasrabudhe, Gargi Banerjee and Anura Kenkre.*
- Effective teaching-learning strategies in Physics: Research-based approaches. 2 sessions in UGC Refresher course for physics instructors. Mumbai University. Jan. 31 and Feb. 4, 2011.
- Instructional design workshop for learning objects. Organized as part of Project OSCAR, NMIMS. January 29 and February 5, 2011. *Jointly with Sameer Sahasrabudhe and Gargi Banerjee.*

### **Invited Talks**

- Transitioning to Online Instruction. Invited Webinar, IISER Pune (August 14, 2020), IISER Thiruvananthapuram (July 23, 2020) and IIT Kharagpur (July 28, 2020).
- Going beyond concepts: Nurturing practices in science and engineering. Webinar at Educational Technology IIT Bombay, May 8, 2020 and invited talk at BITS Pilani, Goa, February 14, 2020.
- Improving learning and learner engagement in f2f and blended settings. Invited talk in Seminar on Training and Development – Bridging the Gaps, Reserve Bank of India. Kochi. March 30, 2019.
- Would technology help in making students better learners? CSI Mumbai TechNext India 2018. February 11, 2018.
- A model to design learner centric MOOCs. Invited talk at Future of Learning Conference, IIM Bangalore, January 15, 2018.
- Large-scale teacher professional development for effective technology integration. Theme-based invited speaker at the 25<sup>th</sup> International Conference on Computers in Education, (ICCE 2017), Christchurch, New Zealand. December 6, 2017.
- Student-centric techniques in f2f classrooms, flipped classrooms and MOOCs: improving learning and engagement. Invited talk at Engineering Conclave, IIT Madras. September 1, 2016.
- Active learning strategies for improving student learning and engagement. Invited talk in seminar on ‘Conversations Across Disciplines – Teaching & Learning’, IIT Gandhinagar. February 13, 2016.
- Active learning strategies for improving student learning and engagement. Colloquium in Department of Electrical Engineering, IIT Bombay. November 4, 2015.
- Learning from digital technologies – cognitive aspects. Invited guest lecture at Tata Institute of Social Sciences, (MA in Education course), TISS, Mumbai. May 21, 2015.
- Peer-Instruction: An interactive learning strategy to promote student conceptual understanding. Session in Symposium on teaching-learning in higher education, IIT Madras. May 28, 2014.
- Computer-based visualizations in facilitating learning: Myths and realities. Invited talk at National Symposium on Future Directions for Technology in Education. SNTD University. March 21, 2014.
- Academic excellence through quality technical education: Challenges and opportunities. Keynote speech at AICTE sponsored national seminar, Thakur College of Engineering and Technology, Mumbai. January 23, 2014.
- Interactive visualizations to develop scientific abilities. Invited seminar at Homi Bhabha Centre for Science Education, TIFR, Mumbai. November 22, 2012.
- Interactive visualizations to develop scientific abilities. Invited seminar at Freudenthal Institute of Science and Maths Education, Utrecht, Netherlands. June 28, 2012.
- Educational Technology: The Why, the What and some of the How. Invited talk at Symbiosis Internal Conference on Open and Distance Learning, Pune. February 23, 2011.

### **Consultancy**

- Evaluation of train-the-trainer course. Naval Institute of Educational Training and Technology (NIETT). 2017.
- Designing pedagogy for FOSS training modules. In-Open Technologies. 2009-10.
- Designing Modules for Computer Teacher Training. In-Open Technologies. 2010-11.

### **Sponsored Projects**

- Edtech Product Rating. Sponsored research project by Central Square Foundation. 2020-23. (PI)
- Creation of gender sensitization modules, Donation account. 2020-21. (co-PI)
- Pedagogy for effective use of ICT by School teachers. Sponsored by Next Education India Pvt Ltd. 2017-20. (co-PI)
- Next Education Research Lab. Endowed lab sponsored by Next Education India Pvt. Ltd. 2017-22. (co-PI)
- Benchmarking digital content. sponsored by Next Education India Pvt Ltd. 2016-18 (PI)
- Project OSCAR, Open Source Courseware Animations Repository. (Co-PI). MHRD-NMEICT project. 2010-14. (co-PI)
- Developing suitable pedagogical methods for various classes, intellectual calibers and research in e-learning. (PI). IITB Coordinator for MHRD-NMEICT project (anchored at IIT Kharagpur). 2010-13.
- OSCAR for physics higher education. (PI) Internally funded MHRD project. 2009-12.
- Learning-centered framework for evaluation of e-learning content. Seed Grant IIT Bombay. 2009-14.

### **Professional Activities**

- Editorial board member, *Research & Practice in Technology Enhanced Learning*, 2019- date.
- Executive Committee Member, Asia Pacific Society of Computers in Education 2014-date.
- Conference organizer: IEEE 18<sup>th</sup> International Conference on Advanced Learning Technologies ICALT 2018, July 9-13, 2018; APSCE 24<sup>th</sup> International Conference on Computers in Education ICCE 2016, Nov. 28 – Dec. 2, 2016; IEEE 8<sup>th</sup> International Conference on Technology for Education T4E 2016, Dec 2-4, 2016; ACM LaTiCE 2016, March 30- April 1, 2016.
- General Chair, 10th IEEE International Conference on Technology for Education T4E 2019. December 4-6, 2019. Goa, India.
- Program co-chair T4E2010, T4E2012, T4E 2014, epiSTEME 2016, ICCE 2016, T4E 2016, ICALT 2018, T4E 2018.
- Steering Committee member, IEEE International Conference on Technology for Education (T4E series), 2010-.
- National Mission on Education through ICT projects: Developing suitable pedagogical methods for various classes, intellectual calibers and research in e-learning. (PI), “Project OSCAR - Open Source Courseware Animation Repository” (co-PI).
- Reviewer for journals: ETR&D, ET&S, IEEE ToE, IEEE TLT, RPTEL.
- Program committee member for international conferences: ICALT, ICCE, CELDA, T4E, ICSLE.