

# INTERDISCIPLINARY PROGRAMME IN EDUCATIONAL TECHNOLOGY

## Annual Report 2019-20

### Introduction

The Interdisciplinary Programme in Educational Technology (IDP-ET) started in the Institute in the Autumn semester of the academic year 2010-11. The IDP-ET conducts research in areas of pedagogies and tools for technology-enhanced learning. In addition to Institute courses for Ph.D. and MTech, the IDP-ET organizes short-term courses and MOOCs on effective teaching-learning with emerging technologies and educational research methods through CEP, NPTEL and IITBombayX. Members of the IDP-ET play a significant role in the organization of international conferences, carry out government and industry sponsored projects, and provide consultancy.

*Noteworthy highlights:*

- Start of M.Tech program: IDP-ET began an M.Tech program in Educational Technology in 2019-20. 6 students were admitted in the first batch. In addition to course work and projects, M.Tech students pursue a 2-month summer internship in educational technology industry or R&D organizations.
- Decade of EdTech: Several events such as seminars, alumni interaction, industry dialogue, and an edtech hackathon have been planned during 2020 to commemorate the 10<sup>th</sup> year of the IDP-ET

### People

*Convener*: Prof Sridhar Iyer

*Faculty members*: 5 core faculty members, 1 adjunct faculty and 17 associate faculty members from academic units across the Institute.

*Academic staff*: 2 post-doctoral research associates and a number of project research staff and interns.

*Alumni*: 15 PhD alumni, who are currently pursuing various careers: post-doctoral researchers in India and abroad, college faculty, e-learning industry, independent consultants, and start-ups.

### Academic Programme

The IDP-ET offers Ph.D. and M.Tech. programmes in Educational Technology.

*Ph.D students*

Currently enrolled: 23

Degrees awarded in 2018-19: 3

*M.Tech students*

Currently enrolled: 6

*Courses*

The IDP-ET continues to offer core courses and electives in various topics in educational technology. These courses have had enrolment from B.Tech, M.Tech and Ph.D students in other academic programmes within the Institute. 8 new courses constituting core and elective courses for M.Tech, and electives for PhD were added.

### Awards

- Members of the IDP-ET received the following international awards from the Association of Educational Communications & Technology (AECT) in 2019.
  - Aditi Kothiyal, Outstanding Student Practice of Educational Technology in an International Setting
  - Sridhar Iyer, International Contribution Award
  - Sahana Murthy, Robert De Kieffer International Fellowship Award
- Best Thesis Award: Aditi Kothiyal. *Thesis*: A model to understand and scaffold novices in estimation problem solving using a technology-enhanced learning environment

## **R & D Activities**

The main research areas of focus of the IDP-ET are:

- **TELoTS**: Technology-enhanced learning of thinking skills focuses on developing students' cognitive skills such as design thinking, problem-posing, estimation, algorithmic thinking, modeling, data representation and analysis, and divergent-convergent thinking. We design, develop and evaluate TELoTS environments for various thinking skills in different domains.
- **TUET**: Teacher Use of Educational Technology focuses on the research-informed development and outreach of ideas and innovations for empowering teachers in effective use of educational technology. Contributions of TUET include models for learner-centric MOOCs and large scale teacher professional development, development of teachers' design thinking, tools and strategies for effective technology integration and analysis.
- **EDA**: Educational data analytics is an emerging field where data pertaining to student behaviour in a computer mediated environment are used to analyse cognitive and affective states. Key EDA objectives are:
  - Use of multimodal data such as mouse clicks, MOOC navigation data, eye gaze information, facial emotion recognition, galvanic skin conductance and brain waves to understand learner behaviour
  - Use machine learning and big data analytics to model and predict learner behaviour
  - Design the next generation of learning products such as intelligent tutoring systems in which the learning content is personalized based on student's prior knowledge, cognition and emotion
- **Emerge**: Identify potential benefits that emerging technologies such as augmented reality, virtual reality, wearable devices etc might afford in the teaching-learning process and design appropriate learning activities with use of such technologies.

## **Sponsored Projects**

- Pedagogy for effective use of ICT by School teachers. Sponsored by Next Education India Pvt Ltd. 2017-20.
- Next Education Research Lab. Endowed lab sponsored by Next Education India Pvt. Ltd. 2017-22.
- Central sector scheme for MOOC compliant e-content (NPTEL Phase IV), sponsored by MHRD. 2016-19.
- Teaching Learning Centre for Information and Communication Technologies (TLC), sponsored by MHRD. 2017-21.
- Educational Services for Outreach at Scale (ESOS) sponsored by MHRD. 2017-22.
- Leveraging eye tracking and allied bio-sensing for education research. IIT Bombay IRCC Seed Grant project.
- Reasoning About Uncertainty and Efficient Decision-making in Engineering Design. IIT Bombay IRCC Seed Grant project.
- Interface development and pilot-testing of a novel classroom feedback system. IIT Bombay IRCC research internship grant.
- Modeling User's Self-Regulated Learning Behavior using Multi-Modal Learning Analytics. IIT Bombay IRCC research internship grant. (2018 - 21).
- An eye tracking based assessment methodology to understand the learning process and fixation duration. IIT Bombay IRCC research internship grant.

### *Completed*

- Impact assessment of mobile-based Spoken English platform. Central Square Foundation. (July 2019 – April 2020)

## **Consultancy Projects**

### *Ongoing*

- Advice on R&D of current and future education projects. Next Education India Pvt Ltd. 2016-19.

## Book Chapters

Sridhar Iyer. Teaching-Learning of Computational Thinking in K-12 Schools in India. In Computational Thinking Education, Eds Siu Cheung Kong and Harold Abelson. Springer (2019).

## Papers published

### Journals

- Biswas, G., Rajendran, R., Mohammed, N., Goldberg, B., Sottolare, R. A., Brawner, K. W., & Hoffman, M. (2019). Multilevel Learner Modeling in Training Environments for Complex Decision Making. *IEEE Transactions on Learning Technologies*, vol. 13 (1), 72-185. doi: 10.1109/TLT.2019.2923352
- Taub, M., Azevedo, R., Rajendran, R., Cloude, E. B., Biswas, G., & Price, M. J. (2019). How are students' emotions related to the accuracy of cognitive and metacognitive processes during learning with an intelligent tutoring system?. *Learning and Instruction*. doi: <https://doi.org/10.1016/j.learninstruc.2019.04.001>
- Mitra, R., Marchitto, T. M., Ge, Q., Zhong, B., Kanakiya, B., Cook, M. S., ... & Lobaton, E. (2019). Automated species-level identification of planktic foraminifera using convolutional neural networks, with comparison to human performance. *Marine Micropaleontology*, 147, 16-24.
- Dasgupta, C. (2019). Improvable Models as Scaffolds for Promoting Productive Disciplinary Engagement in an Engineering Design Activity. *Journal of Engineering Education*, 108(3), 394 - 417. <https://doi.org/10.1002/jee.20282>
- Magana, A. J., Elluri, S., Dasgupta, C., Seah, Y. Y., Madamanchi, A. & Boutin, M. (2019). The Role of Simulation-Enabled Design Learning Experiences on Middle School Students' Self-generated Inherence Heuristics. *Journal of Science Education and Technology*, 28, 382–398. <https://doi.org/10.1007/s10956-019-09775-x>

### Peer-reviewed conference proceedings

- Pathan, R., Shaikh, U., & Rajendran, R. Capturing Learner Interaction in Computer-Based Learning Environment: Design and Application. *IEEE Tenth International Conference on Technology for Education (T4E 2019)*, Goa, India, 2019.
- Singh, A., Mohan, S., Singhal, V., Krishnan, R., & Rajendran, R. What Factors Affect a Primary Student's Performance? *IEEE Tenth International Conference on Technology for Education (T4E 2019)*, Goa, India, 2019.
- Deep, A., Murthy, S., & Bhat, J., (2019). Geneticus Investigatio: A Classroom-Based Technology-Enhanced Learning Environment for Problem-solving Process Skills in Genetics. In *27th International Conference on Computers in Education (ICCE)*, Kenting, Taiwan, Dec 2019. Best Technical Design Paper Award.
- Lakshmi, T. G., & Herold, P. C. (2019, December). Heuristic Evaluation and User Experience Redesign of 'Think & Link' Learning Environment—A Case Study. In *2019 IEEE Tenth International Conference on Technology for Education (T4E)* (pp. 166-169). IEEE.
- Sarkar, P., Kadam, K., & Pillai, J. S. (2019). Collaborative Approaches to Problem-solving on Lines and Angles using Augmented Reality. In *IEEE 10th International Conference on Technology for Education (T4E)* (pp. 193-200). Goa, India: IEEE. doi: 10.1109/T4E.2019.00-24.
- Narayanan, S. & Murthy, S. (2019) Flare-Fork: A pedagogy for expanding problem and solution space for design problem solving. In *27th International Conference on Computers in Education (ICCE)*, Kenting, Taiwan, Dec 2019.
- Kaur, N., Patel, A., & Dasgupta, C. (2019). Collaborative Uncertainty Management While Solving an Engineering Design Problem. *Proceedings of the 13th International Conference on Computer Supported Collaborative Learning 2019*, Lyon, France. June 17 - 21.
- Menon, S., & Banerjee. Evaluating Effectiveness of a Teacher Training MOOC: Industry Perspective. *IEEE Tenth International Conference on Technology for Education (T4E 2019)*, Goa, India, 2019.

- Banerjee, G., & Walunj, S. (2019, December). Exploring in-Service Teachers' Acceptance of Augmented Reality. In 2019 IEEE Tenth International Conference on Technology for Education (T4E) (pp. 186-192). IEEE.
- Chavan, P., & Mitra, R. (2019, December). Developing a Student Feedback System using a Design-Based Research Approach. In 2019 IEEE Tenth International Conference on Technology for Education (T4E) (pp. 1-8). IEEE.
- Kumar, A., Chavan, P., & Mitra, R. (2019, December). Can EEG signal predict learners' perceived difficulty? In Proceedings of the 27th International Conference on Computers in Education.
- Patel, A., & Dasgupta, C. (2019, July). Scaffolding structured reflective practices in engineering design problem solving. In 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT) (Vol. 2161, pp. 287-289). IEEE.
- Kaur, N., & Dasgupta, C. (2019, December). Collaborative and Disciplinary Engagement Levels of the Teams While Managing Engineering Design Uncertainties. In 2019 IEEE Tenth International Conference on Technology for Education (T4E) (pp. 54-60). IEEE.
- Herold, P. C., Dasgupta, C., Murthy, S., & Joshi, A. (2019, July). MathReality: A Bridge from Concrete to Abstract via an AR app for Mathematics Concept of Exponents. In 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT) (Vol. 2161, pp. 282-286). IEEE.
- Herold, P. C., Khwaja, U., Murthy, S., & Dasgupta, C. (2019, December). RoadEthos: Game-Based Learning to Sensitize Children on Road Safety through Ethical Reasoning. In 2019 IEEE Tenth International Conference on Technology for Education (T4E) (pp. 27-33). IEEE.
- Lakshmi, T.G. & Iyer, S. (2020). Teaching-learning of software conceptual design via function-behaviour-structure framework. In Proceedings of the 13th International Workshop on Cooperative and Human Aspects of Software Engineering, Workshop in the 42nd International Conference on Software Engineering, Seoul.
- Prasad, P. and Iyer, S. 2020. VeriSIM: A Learning Environment for Comprehending Class and Sequence Diagrams using Design Tracing. In the 42nd International Conference on Software Engineering, Seoul (ICSE-SEET'20)
- Kaur, N., Patel, A., & Dasgupta, C. (2019). Collaborative and Disciplinary Engagement Levels of Teams while Managing Design Uncertainties. Proceedings of the 10th International Conference on Technology for Education, 2019. Goa, India.
- Ngeze, L. V. & Iyer, S. (2019). Online Teacher Professional Development in ICT Integration in Tanzania: An Experience Report. The 27th International Conference on Computers in Education, Kenting Taiwan, December 2-6, 2019.
- Negi S., Mitra R., (2018). EEG Metrics to Determine Cognitive Load and Affective States: A Pilot Study. UbiComp '18: Proceedings of the 2018 ACM International Joint Conference and 2018 International Symposium on Pervasive and Ubiquitous Computing and Wearable Computers.

#### **Conferences/Symposia/Workshops/Seminars (Participated/ Papers presented)**

- Biswas, G., Rajendran, R. & Munshi, A. Multi-Modal Data Analysis of Students' SRL Behaviors in Open-Ended Learning Environments. American Educational Research Association. Symposium on Multimodal Data during Learning with Advanced Learning Technologies. Toronto, Canada from April 5-9, 2019.
- Kadam, K., Deep, A., Prasad, P., & Mishra, S., Quantitative Evaluation of Concept Maps: An Evidence-Based Approach" In TEEL Workshop Track of the 9th International Conference on Learning Analytics and Knowledge (LAK19), Tempe, Arizona, USA, March 4-8, 2019.
- Shah V., Warriem J., Iyer S., Murthy S. A tutorial on 'Planning, Designing and Orchestrating Learner-centric MOOCs using the LCM model' in International Conference on Computers in Education (ICCE), Kenting, Taiwan, Dec 3-6, 2019.

### **Doctoral Students Consortia papers**

- Ngeze, L. V. & Iyer, S. (2019). Developing a Model for Effective Cascaded School Teacher Training on ICT Integration in Tanzania. A Doctoral Student Consortium Paper. The 27th International Conference on Computers in Education, Kenting Taiwan, December 2-6, 2019

### **Invited Talks**

- Sridhar Iyer. "Are teachers redundant in the age of MOOCs: A teacher's view." Invited talk at KJ Somaiya College of Engineering, Mumbai, April 2019.
- Sahana Murthy. "Developing thinking skills of students in higher education". Invited talk at UGC-RUSA short term course on 'Pedagogic Innovations: Challenges and Transformations in Inclusive Higher Education', SNDT University. May 11, 2019.
- Sahana Murthy. "Designing Learner Centric MOOCs". Keynote at Asia Universities Alliance Online Education Conference, Beijing, July 2019.
- Sridhar Iyer. "Online education initiatives at IIT Bombay". Keynote at Asia Universities Alliance Online Education Conference, Beijing, July 2019.
- Sahana Murthy. "Assessment: For what? How to do it well?" Invited talk at KJ Somaiya College of Engineering, Mumbai, July 2019.
- Chandan Dasgupta. "Strategizing for using Problem-Based Learning in practice" in the PBL South Asia program, partly funded by Erasmus + European Union. This workshop was attended by 65 participants from Finland, Netherlands, Nepal, Bhutan, and India. August 2019.
- Sridhar Iyer. "Computational Thinking in Education." Keynote talk, IEEE International Conference on Technology for Education T4E 2019, Goa, December 2019.
- Ramkumar Rajendran. "NLP in education" at Shah and Anchor Kutchhi Engineering College, Mumbai, for an STTP. January 2, 2020.
- Ramkumar Rajendran. "Effective Pedagogy in Classroom Teaching for Engineering Education" at D. J. Sanghvi College of Engineering, Mumbai. January 8, 2020.
- Sahana Murthy. "Going beyond content knowledge: Nurturing science and engineering practices". Keynote talk at International Conference on Best Teaching Practices for Engaged Student Learning, BITS-Pilani Goa campus. February 2020.
- Sahana Murthy. "Would technology help in making students better learners?" Master Class, University of Goa. February 2020.
- Ramkumar Rajendran. "Introduction to Learning Analytics" at Thakur College of Engineering & Technology, Mumbai, for an STTP. February 26, 2020

### **Conferences chaired**

- Ramkumar Rajendran. Doctoral Consortium Co-chair for IEEE International conference on Advanced Learning Technologies (ICALT) 2019, July 15-18, Maceio, Brazil.
- Chandan Dasgupta. Track Program Chair Coordinator for IEEE International conference on Advanced Learning Technologies (ICALT) 2019, July 15-18, Maceio, Brazil.
- Ramkumar Rajendran. Program Chair of IEEE 10th International Conference on Technology for Education T4E 2019, December 4-6, Goa, India.
- Sahana Murthy. General Chair. 10th IEEE International Conference on Technology for Education T4E 2019. December 4-6, 2019. Goa, India.

### **Continuing Education Programs (CEP)**

- Emerging Technologies for Effective Teaching and Learning. 3-day in-house CEP course for school principals. 2 offerings - September 19-21, 2019 (70 participants) and January 9-11, 2020 (80 participants). Coordinator – Sridhar Iyer. Guest lectures – Sahana Murthy, Ritayan Mitra, Chandan Dasgupta, Ramkumar

Rajendran, Gargi Banerjee.

- 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. Coordinator – Sahana Murthy. Guest lectures – Ramkumar Rajendran, Gargi Banerjee, Sameer Sahasrabudhe.

### **Faculty Professional Development programs**

- ‘Pedagogical Techniques, Teaching & Learning Methods’, 3-day FDP under Pandit Madan Mohan Malaviya National Mission on Teacher and Teaching, MHRD, GoI at Coimbatore Institute of Technology. Conducted twice in April, May 2019. Sameer Sahasrabudhe, Gargi Banerjee, Kapil Kadam.
- Training Seminar on ‘Effective Research Writing’ for in-service Faculty of K. J. Somaiya College of Engineering, May 2019. Sridhar Iyer and Veenita Shah.
- ‘Teaching Pedagogies for Engineering Education’, 3-day FDP at Fr.C.Rodrigues Institute of Technology, Vashi, June 24-26, 2019. Sameer Sahasrabudhe, Gargi Banerjee, Yogendra Pal.
- 1-day session on AICTE sponsored ‘Aligning Curriculum Design & Development, Delivery & Assessment’ at GMR Institute of Technology, Rajam, September, 2019. Gargi Banerjee.
- Training Program on “Effective integration of pedagogy in classrooms” at Gujarat Research Society, Mumbai, for teachers from different schools of Mumbai (46 participants). October 15th, 2019. Sameer Sahasrabudhe and Veenita Shah.
- ‘Effective integration of pedagogy in classrooms’, 1-day workshop, October, 2019. Sameer Sahasrabudhe, Veenita Shah.
- Training Program on ‘Designing Learner Centric MOOCs’ for 40 college faculty at University of Goa, October 12-13th, 2019. Sridhar Iyer, Sameer Sahasrabudhe, Gargi Banerjee and Veenita Shah.
- Online training on ‘Designing Learner-centric MOOCs’ for faculty (16 participants) from the Vellore Institute of Technology, Vellore. November 22-23, 2019. Sameer Sahasrabudhe and Veenita Shah.
- Training on “Design of Learner-Centric MOOCs” for 40 faculty members from Panjab University, Chandigarh. November 2019. Sameer Sahasrabudhe and Veenita Shah.

### **MOOCs**

Faculty, post-doctoral research scientists and PhD research scholars of the IDP-ET designed and taught the following MOOCs on NPTEL and IITBombayX platform:

- Designing Learner Centric MOOCs. 4-week MOOC for school teachers and e-learning curriculum designers. Offered on NPTEL, two offerings in 2019-20. Enrollment 1513 (Jul-Sep 2019), 2114 (Jan-Mar 2020). Sridhar Iyer, Sahana Murthy, Sameer Sahasrabudhe, Jayakrishnan M, Gargi Banerjee
- Introduction to Learning Analytics. 4-week course offered in NPTEL 2019. (Jul -Sep 2019). Ramkumar Rajendran.
- Designing Learner Centric e-learning in STEM disciplines. 4-week MOOC for e-learning curriculum designers, including instructional designers, content developers, teachers or students. Offered on NPTEL in 2019. 622 (Jul-Sep 2019). Sahana Murthy.

### **Workshops Conducted**

- ‘Problem-solving and Process Skills in Genetics using Geneticus Investigatio’. Workshop at St. Xavier's College, Mumbai, August 1 & 8, 2019. Presenter – Anurag Deep.
- ‘Software Conceptual Design Workshop’ organized at Shah & Anchor Kutchi Engineering College, October 7, 2019. Presenters - Rekha Ramesh, Soumya N & Lakshmi T.G.
- ‘Computing Education Workshop’ organized as part of the 12th Annual ACM COMPUTE conference, October 2019. Presenters - Sridhar Iyer, Deepti Reddy, Kavya Alse, Prajish Prasad, Lakshmi T.G.
- ‘Problem-solving and Process Skills in Genetics using Geneticus Investigatio’ Workshop at KET's V.G. Vaze College of Arts, Science & Commerce, Mumbai on October 18 & 19, 2019. Presenters – Anurag Deep.

- ‘Software Design Workshop’ organized at SIES Graduate School of Technology, Navi Mumbai from Dec 16 - 20, 2019. Presenters - Deepti Reddy, Prajish Prasad & Lakshmi T.G.
- ‘Active learning strategies for improving student learning and engagement’. Workshop at International Conference on Best Teaching Practices for Engaged Student Learning, BITS-Pilani Goa campus Teaching Learning Centre. February 2020. Presenters – Sahana Murthy and Rumana Pathan.

### **Honorary Work**

- Executive Committee Member, Asia Pacific Society of Computers in Education (APSCE). Sahana Murthy, Sridhar Iyer. 2014-20.
- International partner and advisory board member for Cyberlearning Consortium (Purdue University). Chandan Dasgupta. 2018-Present
- Chair of SIG on IEEE Technology-Enhanced Learning of Thinking Skills (TELoTS). Chandan Dasgupta. 2018-20.

Faculty, post-doctoral research scientists and PhD research scholars participate as:

- Reviewer for journals: ACM Transactions on Computing Education (ToCE), IEEE Transactions on Education (ToE), Educational Technology, Research & Development (ETR&D), International Journal of Distance Education Technologies (IJDET), Research & Practice in TEL (RPTEL), Interactive Learning Environments (ILE), Journal of Computers in Education (JCE), Cognitive Research: Principles and Implications, IEEE Transactions on Learning Technology (TLT), Journal of the Learning Sciences (JLS).
- International program committee member for various conferences: Artificial Intelligence in Education (AIED 2019), International Conference on Computers in Education (ICCE 2018), International Conference on Computational Thinking Education 2017 (CTE 2018), International Conference on Advanced Learning Technology (ICALT 2019).