

## INTERDISCIPLINARY PROGRAMME IN EDUCATIONAL TECHNOLOGY

### Annual Report 2020-21

#### **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 Ph.D. and MTech programs, 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:***

- *Self-paced course on online teaching:* The IDP-ET faculty and students created this course at the beginning of the lockdown to support instructors in moving towards teaching online. The course is structured as a website containing concepts, videos, information about tools, research-based recommendations and self-check questions with feedback. The website has seen **23000+** visitors so far.
- *Decade of EdTech.* The IDP-ET concluded the activities in 2020-21. Several events such as research seminars by students and faculty, industry interactions, alumni interactions and an EdTech Hackathon were conducted to commemorate the 10<sup>th</sup> year of the IDP-ET.
- *EdTech Hackathon.* IIT Bombay's first EdTech hackathon was organised by IDP-ET with a focus on sparking innovation by integrating research and best practices for designing contextually relevant technology-enhanced solutions for teachers and learners. 15 teams with a total of 51 participant) from all over India joined in the virtual mode and collaboratively worked on problems related to one of the four given themes - Learning everywhere, Learning for everyone, Learning without barriers, and Learning for empowerment. IDP-ET alumni from various parts of the world gave expert talks on designing effective EdTech products. During the competition, IDP-ET M.Tech and PhD students mentored the teams.
- *EdTech Tulna: Creation of quality standards:* The IDP-ET, in partnership with Central Square Foundation is engaged in a project, 'EdTech Tulna' to create research-based quality standards for educational technology products in the Indian context. This project is the first of its kind in India.
- *ET@10.* The IDP-ET recently published a book titled 'ET@10' to commemorate the decade-long journey of this program. The book attempts to feature the culture, practices and processes of this program, that collaboratively works towards achieving collective goals.

#### **People**

*Convener:* Prof Sridhar Iyer

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

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

*PhD alumni:* The IDP-ET has 17 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 Programmes

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

*Ph.D students:* Currently enrolled: 32, Degrees awarded in 2020-21: 1

*M.Tech students:* Currently enrolled: 13

## Awards

- *Sridhar Iyer.* ACM Indian Outstanding Contribution to Computing Education (OCCE) award for the year 2020. This inaugural award is to recognize and respect outstanding contributions made by an individual to computing education while working in India. The citation for his award is: "For promoting computing education research in India through guiding PhD students, developing instructional materials for teachers, implementing outreach at scale and providing consultancy to EdTech industry."
- *Sahana Murthy.* Prof S P Sukhatme Excellence in Teaching Award, 2020, IIT Bombay
- *Veenita Shah, Post-doctoral research scientist.* Augmenting Writing Skills for Articulating Research Award (Annual Award 2020). AWSAR is an initiative of the Department of Science and Technology, Government of India. It attempts to disseminate Indian research in Science, Technology & Innovation being pursued by Ph.D. scholars and post-doctoral fellows in popular science writing format.
- *Sunita Raste and Falegaonkar Vishvanath Bhaurao, PhD research scholars.* Prime Ministers Research Fellowship (PMRF, May 2020). This scheme has been designed for improving the quality of research in various higher educational institutions in the country. With attractive fellowships, the scheme seeks to attract the best talent into research thereby realizing the vision of development through innovation.

## R & D Activities

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

- *TELeaD: Technology Enhanced Learning of Disciplinary Practices* (formerly *TELoTS*). Focuses on investigating and developing students' disciplinary practices. Disciplinary practices encompass the processes, skills and knowledge used by professionals such as scientists, engineers and designers to do work and achieve their goals. Such practices include but are not limited to scientific inquiry, problem posing, modelling, problem formulation and solving, data analysis, estimation, decision making, design thinking, computational thinking, troubleshooting and so on. We design, develop and evaluate TELeaD environments for various disciplinary practices in different domains.
- *TUET: Teacher Use of Educational Technology.* Focuses on the research-informed development and outreach of 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.
- *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 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**

### *Ongoing*

- Next Education Research Lab. Endowed lab sponsored by Next Education India Pvt. Ltd. 2017-22.
- Educational Services for Outreach at Scale (ESOS) sponsored by MHRD. 2017-22.
- Edtech Product Rating. Sponsored by Central Square Foundation, 2020-23.
- Teaching Learning Centre for Information and Communication Technologies (TLC), sponsored by MHRD. 2017-21.
- Personalized Adaptive Tutoring System to Train the Employees, Sponsored by Bank of Baroda Innovation Center, Aug 2020 - July 2022
- Multimodal Learning Analytics for Intelligent Tutoring Systems, Sponsored by Science and Engineering Research Board, Startup research grant. (Jan 2021 - Dec 2022)
- EdTech Hackathon 2021. Project sponsored by Commonwealth Educational Media Centre for Asia (CEMCA) for promoting development of innovative and research-based educational technology products and processes. (Feb 2021 - Jun 2021)
- Leveraging eye tracking and allied bio-sensing for education research. IIT Bombay IRCC Seed Grant.
- Reasoning About Uncertainty and Efficient Decision-making in Engineering Design. IIT Bombay IRCC Seed Grant.
- Modeling User's Self-Regulated Learning Behaviour using Multi-Modal Learning Analytics. IIT Bombay IRCC research internship grant. (2018 - 21).
- Interface development and pilot-testing of a novel classroom feedback system. IIT Bombay IRCC research internship grant.

### *Completed*

- ARPIT - Annual Refresher Programme in Teaching for faculty in Higher Education Institutions through Swayam. MHRD. 2019-2021
- Central sector scheme for MOOC compliant e-content (NPTEL Phase IV), MHRD. 2016-19.
- Pedagogy for effective use of ICT by school teachers. Sponsored by Next Education India Pvt Ltd. 2017-20.

## **Consultancy Projects**

### *Ongoing*

- Advice on R&D of current and future education projects. Next Education India Pvt Ltd. 2016-19.
- Advice on EdTech projects and policy. Central Square Foundation. 2019-2021.
- Development of training modules for promoting Computational Thinking amongst K-12 teachers. Commonwealth of Learning. 2020-2021.

## **Papers published**

### *Journals*

- Pathan, R., Rajendran, R., & Murthy, S. (2020). Mechanism to capture learner's interaction in VR-

based learning environment: design and application. *Smart Learning Environments*, 7(1), 1-15.

- Negi, S., & Mitra, R. (2020). Fixation duration and the learning process: an eye tracking study with subtitled videos. *Journal of Eye Movement Research*, 13(6).
- Deep, A., Murthy, S., & Bhat, J. (2020). Geneticus Investigatio: a technology-enhanced learning environment for scaffolding complex learning in genetics. *Research and Practice in Technology Enhanced Learning*, 15(1), 1-23.
- Sarkar, P., Kadam, K., and Pillai, J. (2020). Learners' approaches, motivation and patterns of problem-solving on lines and angles in geometry using augmented reality. *Smart Learning Environments*. 7, 17 (2020).
- Dasgupta, C., Magana, A. J., & Kirkham, L. (2021). Investigating Teachers' Enactment of Engineering Design Practices in a CAD Simulation-Enhanced Learning Environment. *Computer Applications in Engineering Education*, <https://doi.org/10.1002/cae.22400>
- 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)

#### *Peer-reviewed conference proceedings*

- A. Rane, V. N. John and S. Murthy, "GeoMaps: An interactive application to enhance map comprehension skills of students," 2020 IEEE 20th International Conference on Advanced Learning Technologies (ICALT), 2020, pp. 254-258
- Lotlikar, P., Pathak, D., Herold, P. C., & Dasgupta, C. (2020). Tangible Flowchart Blocks for Fostering Logical Thinking in Visually Impaired Learners. *Proceedings of the 20th IEEE International Conference on Advanced Learning Technologies (ICALT 2020)*
- 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.
- Lakshmi, T. G., & Iyer, S. (2020, June). Teaching-learning of software conceptual design via function-behaviour-structure framework. In *Proceedings of the IEEE/ACM 42nd International Conference on Software Engineering Workshops* (pp. 191-192).
- Shitanshu Mishra, Rwitajit Majumdar, Aditi Kothiyal, Prajakt Pande, and Jayakrishnan Madathil. ENaCT: An Action-based Framework for the Learning and Analytics of Critical Thinking. *International Conference on Computers in Education (ICCE)*, Darwin, Australia, November 2020.

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

- Archana Rane. "GeoMaps: An interactive application to enhance map comprehension skills of students," IEEE 20th International Conference on Advanced Learning Technologies (ICALT 2020), July 6-9, 2020.
- Narasimha Swamy. Investigating the Nature of Learners' Feedback Seeking Actions and its Role in the Development of Representational Competence. 14th International Conference of the Learning Sciences (ICLS 2020), June 19-23, 2020.
- Priya Lotlikar. Tangible Flowchart Blocks for Fostering Logical Thinking in Visually Impaired Learners. IEEE 20th International Conference on Advanced Learning Technologies (ICALT 2020), July 6-9, 2020.

#### **Doctoral Students Consortia papers**

- Chavan, P. (2020). A Novel Feedback System for Pedagogy Refinement and Improvement of Lecture-based Pedagogy. A Doctoral Consortium Paper. The 10th International Learning Analytics & Knowledge Conference (LAK 2020)
- Investigating Learners' Feedback Seeking Behavior and Its Role in the Development of Representational Competence. Narasimha Swamy. 14th International Conference of the Learning Sciences (ICLS 2020) Vol 5 (pp. 2695-2696). Nashville, TN, USA.

### **Invited Talks**

- Sridhar Iyer. "Computing Education Research: Opportunities in India" ACM OCCE Award talk at Compute 2020, Dec 2020.
- Sridhar Iyer. "Computational Thinking in Education". Keynote at CTiS 2020, Oct 2020.
- Sridhar Iyer. "Transitioning from physical classrooms to online instruction." ACM India, Aug 2020.
- Sridhar Iyer. "Transitioning from physical classrooms to online instruction." Invited talk; several IITs.
- Ramkumar Rajendran. "Moving to Online Teaching" Invited talk at DJSCE, Mumbai, June 2020
- Ramkumar Rajendran. "Learning Analytics" Invited talk at NITTTTR Chennai. Dec 2020.
- Ramkumar Rajendran. "Introduction to NLP in Education" at a STTP in Chennai, Jan 2021.
- Ritayan Mitra "Use of psychophysiological sensors in learning process research" at IDC IIT Bombay, Feb 2021
- Ritayan Mitra "Eyes don't lie : Role of eye tracking in the Arts and Sciences" at CU Boulder, USA, October 2020
- Chandan Dasgupta "Facilitating Productive Disciplinary Engagement in an Online Class: Reflections from a Covid-19 hub in India". Invited talk at Computer Supported Collaborative Learning (CSCL) in Times of Crisis webinar series, hosted by International Society of the Learning Sciences (ISLS) and Network of Academic Programs in the Learning Sciences (NAPLeS). March 2021.
- Sahana Murthy. Transitioning to Online Instruction. Invited Webinar: IISER Thiruvananthapuram, IISER Pune and IIT Kharagpur, May-Aug 2020.
- Sahana Murthy. "EdTech Tulna: An index for quality product evaluation", Keynote talk, human-centered design thinking Solveathon & Learning Lab organized by MIT Solve, the Bill & Melinda Gates Foundation, and Better Purpose. Feb. 1, 2021.
- Sahana Murthy. "Improving learning and learner engagement in face-to-face and blended settings". Invited talk at TLC, IIT Hyderabad. February 27, 2021.
- Shitanshu Mishra, "Training Faculty to Conduct Action Research through an Investigation of Student Interests in Computing Programmes Lead investigators"
- Kapil Kadam, Shitanshu Mishra, Pankaj Chavan, Narasimha Swamy, Sunita Raste, "Panel Talk on the National Online Seminar on Unboxing National Education Policy 2020." September 18th, 2020, Newman college, Kerala.

### **Conferences chaired**

- Sridhar Iyer. PC Co-chair for ACM India Compute 2020 Conference, Nagpur. Dec 2020.
- Ramkumar Rajendran. Co-Chair for sub-conference on Advanced Learning Technologies, Learning Analytics, Platforms and Infrastructure, in International Conference on Computers in Education (ICCE 2020), Darwin Australia (Virtual).
- Sahana Murthy. Co-Chair for sub-conference on Learning Sciences and CSCL, in International Conference on Computers in Education (ICCE 2020), Darwin Australia (Virtual).

- Shitanshu Mishra. Co-Chair for sub-conference on Practice- driven Research, Teacher Professional Development and Policy of ICT in Education (PTP), in International Conference on Computers in Education (ICCE 2020), Darwin Australia (Virtual).
- Chandan Dasgupta. Track Co-Chair, IEEE International Conference on Advanced Learning Technologies 2021
- Shitanshu Mishra. Track Co-Chair, IEEE International Conference on Advanced Learning Technologies 2021

### **Workshops and Faculty Professional Development programs conducted**

- ‘Online Teaching’. Self-paced course - <https://sites.google.com/view/iitb-teachonline>; (23,000+ visitors to the site).
- ‘Transitioning to Online teaching’, Moodle course for IITB instructors and TAs. Faculty - Sridhar Iyer, Sahana Murthy. TAs - Ashutosh Raina, Lucian Ngeze, Pankaj Chavan.
- ‘Transitioning to Online Teaching and Learning’. 2-day workshop for RBI Members of Faculty. Sahana Murthy, Ashutosh Raina and Pankaj Chavan. Aug 28-29, 2020.
- ‘DesignAR Classrooms: Towards Designing Augmented Reality Learning Experiences’, at 11th Indian Conference on Human-Computer Interaction, November 5-8, 2020, Kapil Kadam.
- ‘Workshop on designing and conducting research studies’ organized at 13th Annual ACM Compute 2020 held online from December 9th -12th 2020. Presenters - Dr. Shitanshu Mishra, Prajish Prasad, T.G.Lakshmi and Pankaj Chavan
- “Moving from face-to-face teaching to online teaching”, FDP at DIEMS, Aurangabad. April 25, 2020. Pankaj Chavan, Kapil Kadam.
- “Online Validation of Learning Effectiveness and Continuous Assessments" in AMDISA's International FDP on "Digitalisation of Management Education in South Asia". September 2020. Ramkumar Rajendran.
- "Tools and Strategies to Teach and Learn HCI Online", at IndiaHCI 2020, November 5, 2020, Pankaj Chavan, Deepak Padhi

### **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 twice in 2020-21. Sridhar Iyer, Sahana Murthy, Sameer Sahasrabudhe, Jayakrishnan M, Gargi Banerjee.
- Designing Learner-Centric E-learning in STEM disciplines. 4-week MOOC for students, teachers, e-learning content designers and industry professionals. Second offering, Jul-Sep 2020. Sahana Murthy, Veenita Shah, Sunita Raste, Lucian Ngeze
- Demystifying Networking. 4-week NPTEL MOOC for students. Offered (July 2019 and July 2020.)
- Learning Analytics Tools, 12-week MOOC on NPTEL in 2020 (Jul - Nov). Ramkumar Rajendran, Daevesh Singh, Deepak Pathan, and Priya Lotlikar.

### **Honorary Work**

- Associate Editor for IEEE Transactions on Learning Technologies. Sridhar Iyer. 2020-Present.
- Editorial board member for International Journal of Distance Education Technologies. Sridhar Iyer. 2017-Present.

- International partner and advisory board member for Cyberlearning Consortium (Purdue University). Chandan Dasgupta. 2018-Present
- Membership Committee member, International Society of the Learning Sciences (ISLS). Chandan Dasgupta. 2018-Present.
- Communications Committee member, International Society of the Learning Sciences (ISLS). Chandan Dasgupta. 2018-Present.
- Member of the Institute Review Board, IIT Bombay. Chandan Dasgupta. Mar 2020 - Present.
- Member of the Worker's Welfare Committee, IIT Bombay. Chandan Dasgupta. Mar 2020 - Present.
- Executive Committee Member, Asia Pacific Society of Computers in Education (APSCE). Sahana Murthy, Sridhar Iyer. 2014-present.
- Chair for APSCE SIG on Practice-driven Research, Teacher Professional Development and Policy of ICT in Education (PTP), Sahana Murthy, 2019-21.
- Editorial board member, Research & Practice in Technology Enhanced Learning. Sahana Murthy, 2019- date.

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), Journal of Engineering Education (JEE).
- International program committee member for various conferences: Artificial Intelligence in Education (AIED 2021), International Conference on Computers in Education (ICCE 2020), International Conference on Computational Thinking Education 2017 (CTE 2018), International Conference on Advanced Learning Technology (ICALT 2021).