University of Central Florida

Convened:
March 31, 2019 –
April 2, 2019

Synthesis and Design Workshop: Digitally-Mediated Team Learning (DMTL)

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Driving Question / Purpose

Which research will advance effective and scalable *digital environments* for *synchronous team-based learning* involving *problem-solving and design activities* within *grades 6-20 STEM classrooms* for *all learners*?

1/3/5+ Year Research identified via Four Parallel Tracks

T1) Facilitating Team Learning in Real-time via Online Technologies

T2) Personalizing Collaborative Learning through Analytics

T3) Supporting Digital Teams using Active Pedagogical Strategies

T4) Empowering Equitable Participation

5 Themes per Track

a) Activity Authoring
b) Student-Facing
c) Instructor Orchestration
d) XR/Gamification
e) Indexing

Participants *84 from 44 universities*

Carnegie Mellon University
Colorado School of Mines
Concord Consortium
Duke University
Embry-Riddle University
Florida State University
George Mason University
Georgia State University
Georgia Tech
Harvard University
Indiana University
McGraw Hill Education
New York Hall of Science
New York University
North Carolina State Univ.
Oregon State University
Pennsylvania State Univ.
Pepperdine University
Purdue University
Rutgers University
St. John's University
Syracuse University
Texas Tech University
UCLA School of Medicine
University at Albany
University of Calif., Irvine
University of Central Florida
University of Florida
Univ. of Hawaii West Oahu
Univ. of Wisconsin-Madison
University of Michigan
UNC Charlotte
University of North Texas
University of Portland
University of San Diego
Univ. of South Carolina
Univ. of South Florida
University of Tampa
Univ. of Texas at Arlington
University of Texas at Tyler
University of Washington
University of Wyoming
Virginia Tech
Worcester Polytechnic Inst.

In-Field STEM:
Senior: 23%
Junior: 13%

Learning Sciences / Specialists*:
Senior : 27%
Junior : 29%

Doc Students: 8%

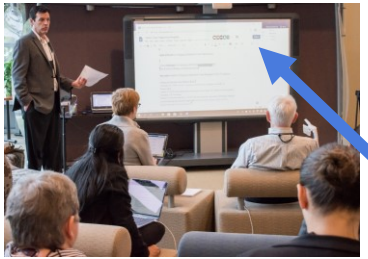
* **Including**: Data Sciences, Digital Media, Medicine, MIS, Philosophy, Psychology, Statistics

Sponsorship

- *NSF Division of Research on Learning:* DRL-1825007
- *Helmsley Charitable Trust:* meals, video/media, costs
- *McGraw Hill Ed:* reception
- *UCF CCIE, CECS, & CGS:* resources, costs

Process

Template-Based approach to Digitally-Mediated Collaboration



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Workshop Flow & Timeline

October 2018 – March 2019
Pre-Activities

- Expertise Profiles
- Position Abstracts
- Track Talking Points

March 31 – April 2, 2019
Orlando, FL
Workshop

Sunday 31 March 2019	Monday 1 April 2019	Tuesday 2 April 2019
Starting 3pm:	▪ Keynote	▪ Keynote
▪ Poster Session	▪ Workshop Overview	▪ Debrief
▪ Demos	▪ Parallel Tracks 1 → 4	▪ Parallel Tracks 1 → 4
▪ Industry Tables	▪ Lunch	▪ Lunch
▪ Social Mixer	▪ Parallel Tracks 1 → 4	▪ Parallel Tracks 1 → 4
	▪ Panel	▪ Action Committee Formation
	▪ Tours	

Qualitative Observation Protocol & Quantitative Data Analysis

April 2019 – June 2019
Post-Activities

Action Committee Chapter Drafts

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White Paper

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NSF Summit

Collaboration Template

Track 1: Facilitating Team Learning in Real-time via Online Technologies

Theme 1C: Instructor Orchestration (Ron)

State of the art for this theme:

Some **challenges** for this theme:

Key works related to this theme (5 to 10 citations):

1-year research objectives:

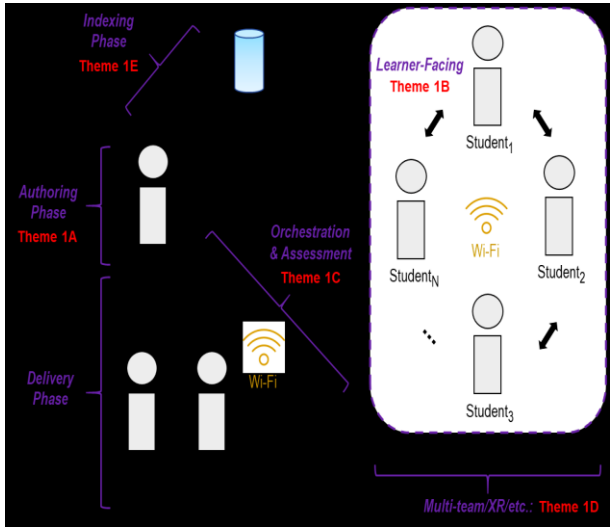
3-year research objectives:

5-year research objectives:

Findings

DMTL increasingly vital to the future of Digital STEM Learning

- **Numerous untapped opportunities** for online instructional environments to *engage, orchestrate, and assess* STEM design and problem-solving teams in classroom settings.
- **DMTL researchers seek to integrate/extend** the excellent interdisciplinary work done continuously since the 1980s via *feature-specific research* towards *systems impact* viewpoints.
- **Proven methods, inexpensive technology, and digitally-receptive students combine** for timely feasibility of center-scale grand challenge given widespread adoption of *mixed-mode delivery* and demands of *enrollment scalability.*
- **Attendees unanimous in the value of a roadmap for DMTL** created in a workshop setting with components/interfaces researched and then *integrated / evaluated / refined* spanning pedagogy, team sciences, machine learning, etc.



Principles

DMTL synergizes powerful learning design principles from multiple complementary research domains

1) DMTL leverages instructional technology during group problem-solving activities

a) Learners co-construct solutions to exercises through ways of thinking (e.g. *design*, *computational*, and *systems thinking*).

b) Team members may *adopt technical/leadership roles* and modify those during the activity.

c) Principles of *peer teaching and learning* are enabled.

2) Instructor serves in supportive roles

a) Technology assists instructor *observation and scaffolding* of team progress in real-time.

b) Rapid formative feedback occurs *during the learning exercise* rather than afterwards.

3) DMTL advances equitable participation

a) Inclusivity encompasses the *human aspects in a community of learners*.

b) Consideration and training of *stakeholders with respect to personal and perhaps unconscious biases further increase participation* and sustainability in STEM.

Surprises & Tensions

Tension: **Contrasts between K-12 vs. Higher Ed.**

- *Origins:* Each domain has been independently advancing DMTL with limited cross-collaboration/exchange.
- *Perspectives:* Contrasting pedagogical knowledge in (K-12 vs. Higher Ed.) & usage in (STEM vs. non-STEM).
- *Differences:* Learner-facing interfaces and assessment benefit from distinct research varying by domain.
- *Constructive Outcome:* Participants commented in the *Workshop Survey* that interactions with diverse disciplines offered new ideas that they could put to work immediately.

Surprise: **Unanimous need for Surveys, Standards, and Clearinghouses**

- *Conceptual Challenges:* Nomenclature challenges of interdisciplinary roles in DMTL.
- *Existing Systems:* need to identify, classify, relate, adapt, and extend these to progress further, but how?
- *Technology Complexity:* Languages, development platforms, updates/change, and obsolescence.
- *Constructive Outcome:* Opportunity to form taxonomies, researcher-facing compendiums/standards, and instructor-facing web resource sites.

Tension: **"Microscope vs. Telescope"** (as promulgated by C. Dede)

Recommendations

- Immediate ***(Imm)***, Near-Term ***(NT)***, and Longer Term ***(LT)***
- Based on White Paper / tables, ASEE-2019 manuscript/poster, and Exit Survey

Imm: Unify research evidence on efficacy of *real-time classroom-based DMTL across delivery modalities* (e.g. co-located, synchronous-but-seated-separately, and mobile-devices) via studies and workshops.

Imm: Assemble *glossary of inclusivity terminology, methods, and metrics* relevant to DMTL. Consider potential advances in equitable participation across the range of interactions enabled within digital teams.

NT: Create *reusable and adaptable DMTL activities with engaging learner interface*s supporting STEM-specific tools (e.g. models, programming, equations, simulations) while employing *analytics for personalization and instructor orchestration of cooperative learning in real-time*.

NT: Create a *Virtual Innovation Center* showcasing high-impact DMTL practices, users, and an adaptable resource repository which leverages methodologies emphasizing interdisciplinary psychophysiological efforts, self-report mechanisms, and inventories to advance inclusivity.

LT: Design *new data science approaches exploring various team formations'* impact on learning outcomes.

LT: Apply and extend *ML/AI technologies within DMTL* to: (a) longitudinally suggest (or automatically construct) team learning activities personalized to the learners at-hand, (b) hybridize DMTL with Intelligent Tutoring Systems (ITS) whereby ITS agents have co-instructor roles, and (c) adapt the XR environment to spontaneously insert virtual teammates at pivotal moments, e.g. triggered by wheel spinning / wrong path.