Building, Supporting, Sustaining Scholarship of Teaching and learning Geometry with Design-based Research on Intradisciplinary and Interdisciplinary Task Sequences

Fall 2023-2024 Faculty Development Leave

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Celil Ekici's Short Bio

- Currently serving as an Associate Professor at Texas A&M University- Corpus Christi where I joined in 2017.
- I have a doctorate in mathematics education from the University of Georgia in 2010.
- For the last 25 years, I have worked as mathematics and STEM education faculty contributing to mathematics education, preservice and inservice teacher education at the University of Georgia, the Middle East Technical University, the University of Virgin Islands, and the Texas A&M University -Corpus Christi.
- My educational research and interests span across K-20 including
    - mathematical modeling,
    - Teaching/learning geometry,
    - Integrated STEM learning
    - applied mathematics education,
    - inquiry-based mathematics teaching/learning,
    - and culturally responsive mathematics education.
- I strive for building and supporting **scholarship of teaching and learning**, collaborative action research with K-20 teachers, students, and local STEM community.

The Project

Driving Idea:

Learners including preservice teachers gain a higher stance by developing connections within and across disciplines

This work is building, supporting, sustaining scholarship of teaching and learning Geometry by conducting

- design-based research on
- Intradisciplinary and Interdisciplinary task sequences
    - We call these dual modeling tasks where learners approaches a learning task from multiple disciplinary interdisciplinary perspectives

Items produced during or as a result of the leave

- Selected Productions on Design-based Research on Intradisciplinary and Interdisciplinary Task Sequences
    - **Research connecting Euclidean and Non-Euclidean Geometries with Dual Learning Tasks**
        - **Ekici, C.** (Accepted). Building a Higher Stance for Teachers by Defining and Constructing Special Quadrilaterals beyond Euclidean Geometry. In P. Herbst, A. Brown (Eds.) *The GeT course: Resources and Objectives for the Geometry Courses for Teachers.* MAA**.**
    - **Research Dual Modeling Task Sequences on Connecting Geometry, Trigonometry, and Statistics**
        - **Ekici, C.** (2024, Presented). *Developing an Advanced Standpoint for Teachers by Connecting Mathematical Disciplines with Dual Mathematical Modeling Cycles and Tasks Sequences*. ICME 15 Conference Proceedings- Mathematical applications and modelling in mathematics education. Sydney, Australia.
    - **Research Dual Modeling Task Sequences on Connecting Geometry, Linear Algebra and Physics**
        - **Ekici, C.** (2024, July Presented). Elementarisation of Mathematics for Undergraduates by Integrating Historical Stances with Trigonometric Functions towards Fourier Methods. Proceedings for The International Study Group on the Relations between History and Pedagogy of Mathematics (HPM 2024). Sydney, Australia.

As a result of my Disseminations of my SoTL work

GeT-a-Pencil community provided an excellent platform for college geometry and high school geometry instructors to reciprocally reflect on their instructional practices and integrate research and scholarship of teaching/learning geometry into their instructional practices

This community allowed Faculty to build collaborations and receive reciprocal Feedback as a Community of Practice on Geometry

- Allowing to reenact my designed learning sequences and receive feedback from other scholars and teachers.

During Fall 2023, I had ample opportunities to present and disseminate my scholarship of teaching and learning geometry to the Faculty learning communities

- Teaching transformation geometry and reflections (including November 2023)
- Building intradisciplinary connections across purposefully designed task sequences

My Contributions during FDL to the Working Groups on Research&Practice in Teaching Learning Geometry

- **Student Learning Outcomes** group
  - Contributed to the working group on Student Learning outcomes in Geometry courses for teachers and high school geometry (ESLO Group)
- **Transformation working group.**
  - Where we examined and built practices with transformations to explore definitions and theorems about congruence, similarity, and symmetry. This group is still active.
  - Presented **Ekici, C. (Nov 2023).** Definitions of transformations, with a special attention to reflections. Online presentation for the transformations working group- GeT Pencil Faculty Learning Community. University of Michigan.
- **Adrinka working Group** for culturally relevant and responsive geometry instruction. As a group we built an observation instrument named as 5Rs framework to critically reflect and improve geometry practice.
  - 5 R's are Rigor, Relevance, Responsiveness, Relationship, Responsibility
  - We analyzed video recordings of geometry lessons integrating culturally relevant practices and implemented 5R framework and refined our observation instrument.
- **Monthly Seminars:**
  - Presented at the monthly webinars, latest one is on May 2024 as a result of this leave

How the project contribute to future scholarship on teaching and learning Geometry

The impact of this research and scholarship of teaching and learning geometry for TAMUCC students and Faculty. This FDL work helped build and expand the *research based innovations in the following courses*:

incorporated into the following courses taught by Dr. Ekici:

MATH 3312- College Geometry,

SMTE 3352 -geometry for elementary teachers,

MATH 5327 Structure of Geometry and Measurement.

MATH 3311 Linear Algebra with its Connections to Geometry and Transformations

MATH 3315 Differential Equations with the geometric analysis approach

Benefiting TAMUCC students and faculty with the research based practices developed.

Sustaining the Scholarship of Teaching and Learning of Geometry Broadening Impact by National & Regional Faculty learning Communities

As a TAMUCC faculty, once connected, I have sustained my collaborations with National Faculty Learning Communities on research in teaching and learning Geometry:

- *GeT-Pencil Faculty Learning Community* coordinated by University of Michigan across more than 10 institutions
- Connected to a faculty network (more than 20 faculty across the nation) who is involved in research and innovations in Teaching and learning Geometry.
- These activities continued into the Spring 2024, and still ongoing in Fall 2024.
    - I shared peer mentoring strategies with Me-by-the SEA conference.
        - Locally, I anticipate I will continue building a faculty learning communities among Geometry teachers across the region during the coming years.
- The FDL opened collaboration and scholarship opportunities for Texas A&M students, faculty and teachers from the region.

Opened new Research Opportunities

- *Informed my current research on effective educational technology integration for Non-Euclidean Geometries:* ongoing research on digital learning experiences to support student learning of non-Euclidean Geometry. Based on on research based task sequences that I designed during the sabbatical with multiple geometric stances, I am comparing the affordances and constraints of the available tha educational technologies including:
  - Hyperbolic Geometry
    - Non-Euclid
    - Pseudosphere on GeoGebra3D
  - Spherical Geometry
    - GeoGebra 3D
    - Spherical Easel

  Manuscript is in preparation for the Journal of *Digital Experiences in Mathematics Education.*

As a result, current joint work and research collaborations

- **With the transformation working group, we have been working on a joint paper building our joint work since Fall 2023**.
    - We examined examine current exemplary practices including mine on transformation based approach to triangle congruence theorem proofs
        - Presented my research based practices in teaching/learning transformations and contributed regularly to the group sessions
    - Implemented 5R framework and refined the observation protocol
    - Conducting lesson study on a jointly designed instructional tasks on triangle congruence theorems during this fall of 2024.
    - Still ongoing biweekly meetings in Fall 2024 since Fall 2023.

Informed my current research: On assessing learning trajectories connecting Euclidean and Non-Euclidean Geometries

Research on the aligned assessments for the Learning Trajectories across Euclidean and Non-Euclidean Geometries:

- Extending design-based research on dual stance learning tasks connecting to other learning tasks beyond special quadrilaterals

- Validating rubrics for intra-disciplinary and interdisciplinary modeling task sequences as a new research directions measuring geometric learning trajectories within and across disciplines

Success strategies for faculty applying for and taking FDL

- Select a research topic that you are deeply committed for at least next several years
- Work with a research group rather than an individual scholar during FDL.
  - Your research agenda should not depend on one individual where you are visiting but a research center where you can have multiple partners
  - Seek common dissemination goals early in your FDL with your partners from the institutions that you are visiting.
- Remain open and flexible to adopt to unanticipated changes and remain committed to pursue your research agenda.

Thanks!

FDL has been a transformative experience for me, my research and practice at TAMUCC. I greatly appreciated the opportunity!

I am very thankful to my department Chair Professor Alexey Sadovski,

my Dean and Provost Office for their support!

I wish the best of success for the Faculty who is applying for FDL to reinvigorate their research and practices.