

Postsecondary Mathematics Teaching Methods and Practices: A National Study

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Introduction

Many students find themselves struggling in college-level coursework despite previous successful secondary academic experiences and acceptable college entrance exam scores (Complete College America, 2015; Woods et al., 2018). There have been few studies that specifically address college mathematics faculty knowledge and utilization of best teaching methods and practices and their effectiveness (Benken et al., 2015; Cox, 2007). Recent research has shown that teachers have the greatest impact on student achievement above any other factor of schooling (Chemosit & Rugutt, 2020; Schriver & Harr Kulynych, 2021). Therefore, the researcher explored teaching methods and practices utilized by faculty in the U.S.

Literature Review

Many faculty heavily rely on lecturing and/or direct instruction for most to all of the course and may not know about other teaching methods and/or practices (Blair et al., 2018; Mathematical Association of America, 2017; Mesa et al., 2014; Ngo, 2020; Oleson & Hora, 2014). Unlike PK-12 teachers, faculty are not required to obtain teaching certifications, licenses, or participate in internships or mentorships; they are only required to have an advanced degree (Blair et al., 2018; Chiu & Corrigan, 2019; Gilmore et al., 2014; U.S. Bureau of Labor Statistics, 2016). Inexperience and lack of support may contribute to the heavy use of lecture and/or direct instruction (Fong & Zientek, 2019; Purnomo et al., 2018).

Methodology

This sequential explanatory mixed methods study took place in postsecondary institutions in the U.S. Cluster-random sampling was used to select institutions. Mathematics department chairs were sent a survey containing the TPI (*Teaching Practices Inventory*), ATI (*Approaches to Teaching Inventory*), and demographic questions to forward to faculty (full-time, part-time, tenure-track, and non-tenure track) (Trigwell & Prosser, 2004; Wieman & Gilbert, 2014). It was hypothesized that demographic groups would reveal statistically significant differences in TPI scores, ATI classifications (information-transmission/teacher-focused (ITTF) and conceptual change/student-focused (CCSF)), and between the TPI and ATI. The research questions (RQ): (1) Are there statistically significant differences in the TPI score performance between faculty demographic groups, methods, or practices? (2) What similarities and differences can be found in the ATI classification between faculty demographic groups, methods, or practices?

Results

There were 113 participants from 37 states. For the first RQ, the significant demographic group was membership. The testing revealed that faculty who were members were more likely to utilize more methods and practices that focus on their students. For the second RQ, demographic groups did not reveal significant findings, but individual methods and practices were significant. Faculty who reported utilizing the inquiry, problem-based learning and cooperative learning teaching methods were more likely to be classified by the ATI as CCSF. Also, faculty who utilized more than three methods were more likely to be classified as CCSF. Qualitative and mixed method results are still in progress.

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Postsecondary Mathematics Teaching Methods and Practices: A National Study

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Background

Many students find themselves struggling in college-level mathematics courses (Complete College America, 2017; Woods et al., 2018).

- Teachers have the greatest impact on student achievement (Chemosit & Rugutt, 2020; Schriver & Harr Kulynych, 2021).
- There have been few studies that specifically address college mathematics faculty knowledge (Benken et al., 2015; Cox, 2007).

Therefore, the researcher explored teaching methods and practices utilized by faculty in the U.S.

Quantitative Research Questions

1. Are there statistically significant differences in the TPI score performance between faculty demographic groups, methods, or practices?

2. What similarities and differences exist in the ATI classifications Conceptual Change/Student-Focused (CCSF) or Information Transfer/Teacher-Focused (ITTF) between faculty demographic groups, methods, or practices?

Methods

This study was conducted using sequential explanatory mixed methods.

Quantitative Participant Selection Process:

Institution Selection

Chose institution by type (2-year, 4-year, university) and geographic location

Targeted Participants

Department chairs were notified and forwarded the survey to the participants

Items in Survey to Participants:

TPI

Results in a score for practices (Wieman & Gilbert, 2014)

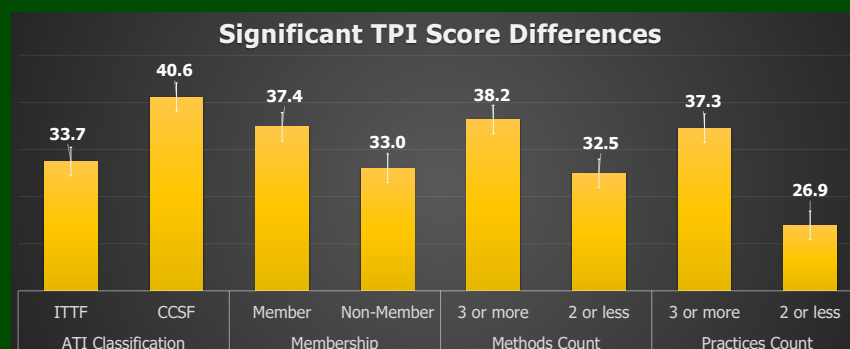
ATI

Results in a classification of either conceptual-change/student-focused (CCSF) or information transfer/teacher-focused (ITTF) (Trigwell & Prosser, 2005)

Teaching methods are defined by Kilbane and Milman (2014)

Teaching practices are defined by NCTM (2014).

Faculty who were **student-focused** were **more likely** to utilize **more practices** and **methods** in their classrooms than those who were teacher-focused.
Membership in professional organizations also correlated with the use of **more practices**.



CCSF Classification Significant Results

Group	Chi-Squared Value	Probability
Lecture (M)	4.36	0.0368
Inquiry (M)	5.39	0.0203
Problem-Based Learning (M)	5.07	0.0243
Cooperative Learning (M)	5.84	0.0157
Goals (P)	4.06	0.0440
Build Procedural Fluency from Conceptual Understanding (P)	4.59	0.0322
Method Count (3 or more)	9.03	0.0027

Note: M=Method, P=Practice

ITTF Classification Significant Results

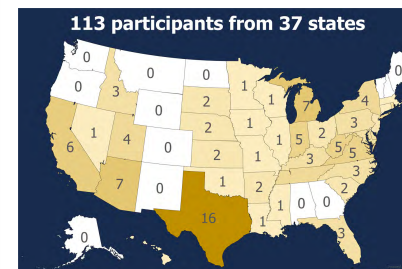
Group	Chi-Squared Value	Probability
Lecture (M)	8.27	0.0040
Inquiry (M)	8.55	0.0035
Problem-Based Learning (M)	7.56	0.0060
Cooperative Learning (M)	8.41	0.0037
Goals (P)	4.42	0.0354
Methods Count (3 or more)	11.01	0.0009

Note: M=Method, P=Practice

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Results



Most Frequent Methods and Practices

- Direct Method: n=85 (75.2%)
- Lecture Method: n=45 (39.8%)
- Problem-Based Learning Method: n=35 (31.0%)
- Implementing Tasks Practice: n=65 (57.5%)
- Mathematical Representations and Connections Practice: n=56 (49.6%)
- Productive Struggle Practice: n=52 (46.0%)

Chi-squared testing revealed that these variables were significant for the ATI classifications. Phi coefficients were calculated to determine an association, which is similar to a regression score.

Positive Association with CCSF ($\phi > 0.2$)

- Inquiry, Problem-based learning, and Cooperative learning methods
- Use of 3 or more teaching methods

Positive Association with ITTF ($\phi > 0.2$)

- Lecture
- Procedural Knowledge from Conceptual Understanding

Negligible Association ($0 < \phi < 0.2$)

- Setting Goals

Discussion

- Faculty who were members of a professional organization had statistically significantly higher TPI scores, which means more practices are being utilized in their classrooms.
- Faculty who reported utilizing the inquiry, problem-based learning, and cooperative learning teaching methods or a combination of multiple methods were more likely to be classified as CCSF (conceptual-change/student-focused) than faculty using other methods.
- Qualitative themes emerged and include faculty experiences as students, professional development, teaching experience, and personal connections.
- Integration of results is in progress.

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