Exploring Relationships Between Faculty Values for and Practice in Developing Student Quantitative

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FSSE faculty survey of student engagement

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Background

- Quantitative reasoning is defined as the ability to analyze or interpret real-world statistical information (Rocconi et al., 2013).
- The American Association of Colleges and Universities (AAC&U) lists quantitative literacy as an essential practical skill (AAC&U, n.d.).
- Colleges and universities play an important role in preparing students with career skills (Hurney et al., 2011).
- Employers find quantitative reasoning and other practical skills crucial for students' career success (Finley, 2021).
- Few studies have explored faculty perceptions of the importance of quantitative reasoning and their contribution to the development of students' skills.

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Framing Perspectives and Literature

Quality Teaching is Important to Quality Learning

- Positive relationship between faculty quality teaching and students' quality education (Kezar, 2014; Umbach & Wawrzynski, 2005).
- Faculty perceptions and effective teaching practices affect student engagement and learning outcomes (Kezar, 2014; Umbach and Wawrzynski, 2005).
- Faculty rely on their personal beliefs and disciplinary norms to guide their curricular choices (Andreson et. al., 1985; Stark, 2000; Warcholak, 2014) .
- Faculty beliefs about their discipline and how students learn are the strongest influences on faculty instructional choices (Stark, 2000; Stark et. al., 1988).

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Framing Perspectives and Literature

Quantitative Reasoning in Workforce Success

- Faculty and administrators at colleges and universities have perceived the importance of quantitative reasoning and incorporated quantitative reasoning experience into their courses (Elrod, 2014).
- Quantitative reasoning teaching practices have yet to be expanded commonly across different disciplinary areas as students in STEM fields are more likely to engage in quantitative reasoning-related activities than their non-STEM peers (Rocconi et al., 2013).

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Research Questions

1. How do faculty perceptions of the importance of quantitative reasoning relate to the ways they structure their courses to help develop students' career-related skills?
2. How do faculty perceptions of the importance of quantitative reasoning relate to how they encourage students they teach or advise to participate in transferrable skill- or career-related activities?
3. How do the relationships in the previous two questions differ across disciplinary areas?

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Data

Faculty Survey of Student Engagement

- 2021 & 2022 Administration
- Core Survey + Transferable Skills Module (optional additional items)
- 4003 faculty responses
- 31 Institutions

Table 1. Faculty Characteristics

	Count	%
Disciplinary area		
Arts and Humanities	860	24.6
Biological Science, Agriculture, & Natural Resources	262	7.5
Business	321	9.5
Communications, Media, & Public Relations	233	6.7
Education	323	9.2
Engineering	180	5.1
Health Professions	274	7.8
Physical Science, Mathematics, & Computer Sciences	295	8.4
Social Sciences	418	12.0
Social Service Professions	87	2.5
Other disciplines	244	7.0
Academic rank		
Professor	768	24.5
Associate Professor	618	19.7
Assistant Professor	549	17.5
Instructor or Lecturer	784	25
Others	419	13.4
Gender Identity		
Man	1373	44.1
Woman	1558	50.0
Another gender identity	22	0.7
I prefer not to respond	160	5.1
Race/Ethnicity		
American Indian or Alaska Native	10	0.3
Asian	194	6.2
Black or African American	286	9.2
Hispanic or Latino	104	3.3
Middle Eastern or North African	97	3.1
Native Hawaiian or other Pacific Islander	3	0.1
White	2035	65.4
Another race or ethnicity	27	0.9
Multiracial	123	4.0
I prefer not to respond	234	7.5

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Measures

Quantitative Reasoning (QR)

In your selected course section, how important is it to you that the typical student do the following? (*Response options: 4 Very important, 3 Important, 2 Somewhat important, 1 Not important)*

- Reach conclusions based on their own analysis of numerical information (numbers, graphs, statistics, etc.)
- Use numerical information to examine a real-world problem or issue (unemployment, climate change, public health, etc.)
- Evaluate what others have concluded from numerical information

Work-related Course Goals (CG)

To what extent do you structure your selected course section so that students learn and develop in the following areas? (*Response options: 4 Very much, 3 Quite a bit, 2 Some, 1 Very little)*

- Acquiring job- or work-related knowledge and skills
- Working effectively with others
- Developing or clarifying a personal code of values and ethics
- Understanding people of other backgrounds (economic, racial/ethnic, political, religious, nationality, etc.)

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Measures

Professional Transferrable Skills (TRN)

During the current school year, whether course-related or not, to what extent have you encouraged students you teach or advise to do the following? *(Response options: 4 Very much, 3 Quite a bit, 2 Some, 1 Very little, 0 Not at all)*

- Network with alumni or professionals to make potential career connections
- Communicate your knowledge, skills, and experiences to potential employers
- Use career-specific technology (devices, programs, or tools used by those in the field)
- Research a career interest, a potential employer, or the job market
- Learn about a career or industry from practicing professionals

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Analysis

- Exploratory Factor Analysis (EFA)
- ANOVA & Tukey Post-hoc comparison,
- Structural Equation Modeling
  - Confirmatory Factor Analysis (CFA)
  - Multi-Group Analysis
- Robust Criteria based on Hu and Bentler (1999):
  - chi-square ($\chi 2$),
  - CFI > .95
  - TLI > .95
  - RMSEA < .05.

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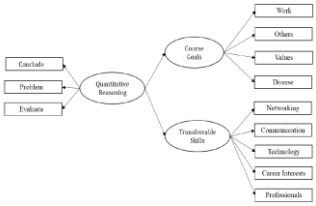
Measurement Model

- Chi-square $\chi 2(51) = 1306.94$, p-value < .001, CFI (.923), TLI (.900), and RMSEA (.095).
- Correlated the error terms of items from the course work and the transferrable skill scale.
- Improved goodness of fit, chi-square ($\chi 2(45) = 358.848$, $p <$ .001), CFI (0.981), TLI (0.972), RMSEA = 0.05



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Parameter and the Regression Estimates

Parameter Estimates of Structural Model

Variables	Estimate	SE	p-value	Variance
Quantitative Reasoning				
Conclude	1			.55
Problem	1.26	.03	< .001	.18
Evaluate	1.13	.03	< .001	.29
Course Goals				
Work	1			.46
Others	.80	.04	< .001	.61
Values	.89	.04	< .001	.62
Diverse	.71	.04	< .001	.89
Transferrable Skills				
Networking	1			.66
Communication	1.07	.02	< .001	.47
Technology	.86	.02	< .001	.98
Career Interests	.99	.02	< .001	.70
Professionals	1.07	.03	< .001	.59
Regressions				
Quantitative Reasoning				.64
Course Goals	.30	.02	< .001	.55
Transferable Skills	.39	.03	< .001	.95

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ANOVA

ANOVA Results for Three Latent Constructs across Disciplinary Areas

	Quantitative Reasoning		Course Goals		Transferrable Skills	
F (Significance)	69.47	***	35.55	***	9.77	***
Disciplinary Area	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Arts and Humanities	2.1	.96	2.8	0.72	1.9	1.11
Biological Science, Agriculture, & Natural Resources	3.1	.80	2.4	0.79	1.9	1.08
Business	3.0	.81	2.7	0.79	2.1	1.08
Communications, Media, & Public Relations	2.9	.93	2.8	0.78	2.3	1.04
Education	3.1	.84	3.2	0.69	2.3	0.98
Engineering, Physical Science, Mathematics, & Computer Sciences	3.0	.84	2.5	0.84	1.9	1.11
Health Professions	2.9	.87	2.9	0.77	2.2	1.08
Social Sciences	2.9	.89	2.7	0.75	2.0	1.02
Other disciplines	2.7	.94	3.1	0.74	2.3	1.08

Note. *p < .05, **p < .01, ***p < .001

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Multi-Group Analysis

Multi-group analyses across disciplinary areas

Disciplinary Area	Course Goals			Transferrable Skills		
Latent Variable (Quantitative Reasoning)	Estimate		SE	Estimate		SE
Arts and Humanities	.27	***	.03	.34	***	.05
Biological Science, Agriculture, & Natural Resources	.29	***	.07	.36	***	.10
Business	.29	***	.05	.32	***	.08
Communications, Media, & Public Relations	.25	***	.07	.11		.08
Education	.08	*	.04	.18	*	.07
Engineering, Physical Science, Mathematics, & Computer Sciences	.21	***	.04	.37	***	.07
Health Professions	.19	**	.06	.33	***	.08
Social Sciences	.17	***	.04	.39	***	.06
Other disciplines	.21	***	.05	.42	***	.07

Note. *$p < .05$, **$p < .01$, ***$p < .001$

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Limitations

- Results are not generalizable as institutions interested in collecting information on faculty practice related to transferable skills may be different from a randomly selected group.
- We lack student data to support the success of student development of quantitative reasoning skills despite the direct relationship between faculty practice and student performance.
- The relatively small count of faculty in our study means that our results should not be taken as true for all faculty at all institutions.

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Discussions & Implications

- We provide further evidence that disciplinary norms drive curricular decision making.
  - Faculty developers can help to make sure faculty in all fields see the value in QR and help to incorporate relevant activities in their courses.
- Individually, however, regardless of discipline, if faculty value quantitative reasoning, they are more likely to include relevant activities in their courses.
  - A focus on faculty values and practice are important for institution goals to prepare students for workforce success
- Future research should further explore relationships in this study while accounting for other faculty demographics, employment characteristics, and institution types.

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Any Questions or Comments?

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Any questions? Please email me at tienhu@iu.edu

For more information about the Faculty Survey of Student Engagement (FSSE), visit https://nsse.indiana.edu/fsse/ or email at fsse@indiana.edu

Indiana University Bloomington

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