The Shared Experiences of Non-Traditional Groups in Academic STEM Disciplines

Kimberly Luthi
Embry-Riddle Aeronautical University, kimberly.luthi@erau.edu

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The Shared Experiences of Non-Traditional Groups in Academic STEM Disciplines

MSU-Facility for Rare Isotope Beams
Virtual Nuclear Science Seminar
March 29, 2023

Dr. Kimberly Luthi
Dr. Kimberly Luthi, Ph.D.

- **Appointments**
  - Faculty, College of Aviation, Embry-Riddle Aeronautical University-Worldwide
    - Associate Program Chair, BS Uncrewed Systems Applications
    - Research Coordinator, College of Aviation
  - Resource Development Officer, Business Operations, Embry-Riddle Aeronautical University-Worldwide
  - Grants Development Manager, Valencia College
  - Grants Development Officer, Daytona State College

- **Professional Involvement**
  - American Airlines Workforce Assessment Team
  - Future Workforce Directions Space Operations Assessment Team
  - Women Leadership Development-OPE Curriculum Development Team
  - PI, National Science Foundation Grant, Improving UG STEM education
  - College Council President
  - Faculty Liaison Fulbright
  - Council for Advancement and Support of Education, Federal Agency Liaison Committee and Federal Funding Task Force Lead

- **Education**
  - Ph.D. Higher Education, CCL, May 2020, Old Dominion University
  - M.S. Aviation, May 2022, Embry-Riddle Aeronautical University
  - M.A. Education, Student Personnel in Higher Education, May 2009,
  - University of Florida
  - B.A. History, May 2004, University of Florida
Significance

- The results of this effort resulted in the identification of factors that can be used as a conceptual framework for establishing institutional conditions and a work environment across higher education institutions that support women’s advancement and retention in academic appointments of leadership related to STEM disciplines and workplace education.
- The research considers relevant literature related to current institutional strategies and predictors for women’s success and retention in STEM disciplines.
- Such an exploration addresses challenges of non-traditional groups, specifically gender inequity issues regarding women’s advancement in STEM.
Areas of Focus in Current Literature

STEM Pipeline:
1. STEM Professionals
2. Gender equity in secondary and postsecondary STEM disciplines
3. Persistence and retention of women in STEM

The Advancement and Hinderance Factors of Women in STEM:
1. Stereotype threat
2. Societal gender bias
3. Psychology of women in STEM leadership positions
Cultural Change in Academia:
1. Perceptions of female faculty in STEM
2. Viable advocates
3. Persistence and retention of women in STEM

The Role of the Institution
1. Faculty and administrative perceptions
2. Policy review and reform
3. Institutional types
4. Workplace environments
Women’s representation among STEM doctorates has also increased dramatically over time, although it varies by field.

Source: National Science Foundation, Division of Science Resources Statistics of Tables 34, 35, 38, & 39. (NSF 08-321)
Women are underrepresented in many science and engineering occupations.

Percentage of Employed STEM Professionals Who Are Women, Selected Professions

Pay Gap

The *Chronicle of Higher Education* Almanac (2022) confirms shows that women earned only 85% to 87% of what male counterparts did. Salaries for both men and women have risen steadily since 2001. The chart below shows the gender pay gap over the past 15 years for administrators in higher education.
The Academic Conversation

The Retention of Women in STEM

Climate of Two-Year College and University STEM departments

Influence of Bias

Social and Environmental Factors that shape experiences
Conceptual Framework: What factors contribute to women’s abilities to advance in STEM leadership?

The study explored institutional conditions conducive to women’s advancement and retention in STEM and workforce education in higher education such as:

• Exposure for women to successful role models in math and science.

• Changes in institutional policy for more inclusive environments to challenge gender inequities.

• Monitoring the climate of science and engineering departments at colleges and universities to create inclusive programs for women.

• Providing mentoring and early career advising for junior faculty.

• Implementing effective work-life balance policies to support faculty.

• Challenging bias that limits women’s advancement into STEM fields.
This research was guided by two specific questions that were addressed through data collection and analysis:

1) What factors have the most impact on women’s professional advancement and success in leadership positions within STEM and workforce education-related disciplines at two-year degree offering institutions?

2) What factors inhibited women’s professional advancement and success in leadership positions within STEM and workforce education-related disciplines at two-year degree offering institutions?
RESEARCH DESIGN

Delphi Technique
The questionnaires were guided by the survey design and follow Schmidt’s (1997) framework for ranking factors in the panelists’ responses. The study included four rounds:

R1) identifying factors related to both research questions;

R2) consolidating the list of factors identified by the panelists and identifying any additional factors missing from the list.

R3) rating the list from most relevant to least relevant as it relates to the research questions;

R4) obtaining group consensus on the final factors that were previously identified and rated.
SAMPLE POPULATION

1) Former and current administrators who oversee STEM and workforce education related programs at two-year degree offering institutions

Panelists were asked to self-disclose information regarding their current and previous roles in administration within STEM and additional qualifications such as experiences and research background in STEM-disciplines

2) Active members in a national or regional STEM organization and programs that promotes broadening participation of women in STEM.

3) Female

4) Must have held a Ph.D. or terminal degree in their STEM-related field.
SELECTION CRITERIA

An initial purposive sample of 10 former and current administrators identified by the researcher were invited to participate in the study based on their qualifications.

A snowball sampling technique was used to recruit additional eligible panelists from among their peers based on established criteria.

A minimum of 20 panelists were selected to participate in the first round to adjust for attrition effects in the second and third rounds to ensure a minimum of 10 respondents within the last round.
DESCRIPTION OF THE SAMPLE

- An introductory email was sent out to the most appropriate individuals to serve on the panel based on their expertise and career longevity within STEM and understanding of issues related to leadership and gender equity within STEM fields.

- 28 emails were sent out by Feb. 24th, 2019.

- 20 panelists agreed to participate in the study

- Panelists were asked to include specific demographic information to confirm their name, their affiliated institution that offered two-year degree programs, their former or current administrative role in STEM or a workforce education related field.
DESCRIPTION OF THE SAMPLE

The STEM clusters: Round 1 representation included 17 out of 20 (85%)

- Mathematics (6)
- Workforce education (4)
- Health (3)
- Engineering (2)
- Aeronautics (1)
- Environmental sciences (1)

Administrative positions included

- Deans within a STEM academic discipline (8)
- Principal investigators and directors who served in administrative roles and oversaw federally-funded STEM and STEM-related workforce education programs (6)
- Assistant Vice Presidents over STEM and workforce education related programs (3)
Round 1

- Panelists were instructed to provide two to three factors and a few sentences describing each factor or related experience for context.
- A review committee categorized the factors by similarities and themes and consolidated them to 22 factors total.
- The factors identified included 10 supporting advancement and 12 inhibiting advancement.
Round 2

• Panelists were asked to review the categorized list of factors and either confirm their approval of the list or add additional factors if necessary.

• On April 5, 2019, 17 panelists were emailed and 12 responded without changes and five panelists responded with modifications and additional factors.

• The number of related factors and description increased from 10 to 13 factors that support advancement and 12 factors that inhibit advancement for a total of 25 factors.
Round 3

- The panelists' opinions were requested to rate the importance and/or relevance of each factor identified and/or modified in Rounds 1 and 2 of the study.

- The rating scale used a five-point Likert-type scale with a numeric value (e.g. 5 points = Most Relevant Factor, 4 points = Significant Relevant Factor, 3 points = Moderate Relevant Factor, 2 points = Limited Relevant Factor, and 1 point = Not Relevant Factor).

- On April 21st, 2019, 17 panelists were emailed and 15 panelists responded (88%).
Round 4

The panelists had the opportunity to change their ratings in Round 4 after considering their individual ratings in Round 3 compared to the group mean ($M$), median ($Md$), $IQR$, and standard deviation ($SD$) for each factor.

Although the group median and mean will be presented to the panelists in Round 4, the researcher established a factor as relevant based on a mean score of 3.50 or higher on the 5.00 scale based on Delphi studies that used a similar cut off score as appropriate (Kosloski & Ritz, 2016; Martin & Ritz, 2012; Pate, Warnick, & Myers, 2012).
Round 4

- Consensus by the panelists had been reached for 24 of the 25 factors (96%).

The researcher established that consensus was reached for any factors with an interquartile range of 2.00 or below based on similar studies that used 2.0 as an acceptable cut off score (Childress & Rohodes, 2006; Kosloski & Ritz, 2016).

Factors with an interquartile range (IQR) over 2.0 indicates that consensus was not gained due to the high dispersion of the ratings for each factor.
Relevant Factors Identified

RQ 1: 9 of 12 factors reached a 3.5 or higher for factors that support advancement

- Support Systems, $M = 4.40$
- Personal Attributes, $M = 4.13$
- Willingness to Advance, $M = 4.07$
- Leadership Skills, $M = 4.00$

RQ 2: 3 of 12 factors reached a 3.5 or higher for factors that inhibited advancement

- Curiosity about New Experiences, $M = 3.73$
- Role Models, $M = 3.73$
- Opportunities for Leadership Roles, $M = 3.67$
- Experiences in Undergraduate and Graduate, $M = 3.67$
- Awareness for Institutional Environment, $M = 3.60$

- Conflicting Family Obligations, $M = 4.00$
- Lack of Compensation, $M = 3.67$
- Personal Concerns, $M = 3.53$
DISCUSSION
Discussion of the Findings

The results of the Delphi study can be used to inform administrators and researchers in higher education on the relevant factors concerning organizational climate, institutional policies, and departmental conditions that impact women’s advancement or hinder their advancement in STEM fields.

Through the four rounds of the Delphi study, **50% (12 or 24)** of the identified factors were considered relevant and reached consensus by the panelists.

The identified factors such as Conflicting Family Obligations ($M \, 4.0$) can drive conversations between educators and policy makers in the designing high-quality programs and organizational support for women aspiring to be in leadership roles in STEM and workforce education-related programs.

Policies regarding family-friendly work conditions with flexible hours can be considered so women don’t feel they will be passed over for promotion due to conflicting scheduling issues and personal concerns.
## Theoretical Framework Guiding the Study

<table>
<thead>
<tr>
<th>Recent Graduates</th>
<th>Early and Mid-Career Transitions</th>
<th>Context of Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math and science self-efficacy builds</td>
<td>Intent and willingness to advance in STEM fields</td>
<td>Entrance into an overall STEM Community and Network of Support</td>
</tr>
<tr>
<td>Exposure to career mentors and role models</td>
<td>Self-confidence and self-efficacy builds</td>
<td>STEM identity development through a support network and connection to STEM role models</td>
</tr>
<tr>
<td>Early achievements and skills development in STEM leadership positions</td>
<td>Connection to STEM Community</td>
<td>Understanding of personal attributes that influence career trajectory</td>
</tr>
<tr>
<td>Support community of teachers and peers in graduate programs</td>
<td>Work-life integration</td>
<td>Exposure to career opportunities</td>
</tr>
</tbody>
</table>

### Context of Barriers

**Life/Career Stages:** Prolonged time to advancement and limited recognition for work achieved along the STEM pathway.

**Social and Cognitive Development Needs:** Conflicting family obligations and detachment from a STEM community; Limited support and lack of compensation from institutions; Personal concerns and lack of connection to peers and faculty.
High Engagement of Women in STEM Leadership Positions

**Challenges**
- Personal Concerns
- Lack of Compensation
- Family Obligations

**High Output:**
Application of leadership skills and professional development
Willingness to advance

**Post-Secondary Recruit ➔ Early Career Engagement ➔ Increased Commitment to Advance**

**Advancement**

**Presence of Women in Leadership**

**High Engagement of Women in STEM Leadership Positions**
LIMITATIONS

- Only two-year institutions
- Only academic settings
- Only certain STEM fields were represented
- Students and Industry representatives were not included
ASSUMPTIONS

* Panelists view advancement as a positive outcome in their career trajectory

* Panelists are aware of potential gender inequity and other gender equity issues cite in the literature.

* Factors that impact women’s advancement and success as well as hinder advancement can be determined by experts serving in position of leadership

* Panelists are accurately representing themselves with regards to eligibility for the study requirements
QUESTIONS


