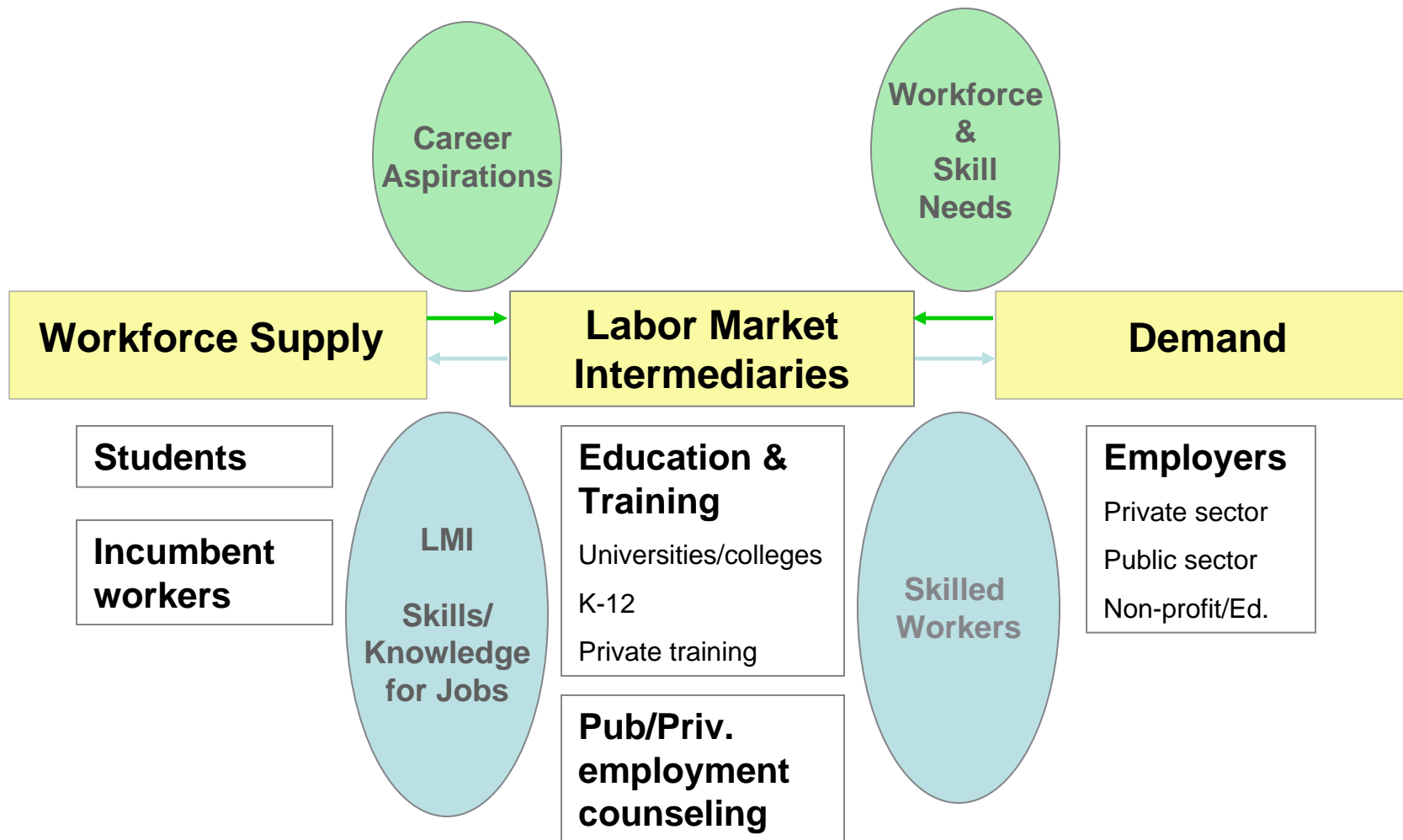


# **Trends in the Development of Nanotechnology Degree Programs in the United States**

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# Model of Labor Market Demand & Supply Interactions



# Setting the Stage: Understanding Employer Demand for Nanotechnology Skills and Degrees

Questionnaire and interviews with nanotechnology firms in Arizona

- Motorola
- FreeScale
- Raytheon
- General Dynamics

Case studies of pharmaceutical and biotechnology firms in New Jersey

- Merck
- Schering-Plough

## Industry Focus

- Aerospace
- Biotech
- Semi-electronics

## Job Focus

- R&D

## Industry Focus

- Pharma
- Biotech

## Job Focus

- R&D
- Manufacturing
- Corporate

# Demand: Key Findings

- **The use of nano affects R&D jobs most, but also Mfg. & Corp. jobs to a lesser degree.**
- **Some employers cautious about nano-specific degrees.**
  - ❖ Employers report that workers trained in **traditional disciplines** possess much of the core knowledge/skills needed to **learn the basics of nanotechnology research on the job.**

# Demand: Key Findings (Cont'd)

**However, interdisciplinary knowledge and key nano-related skill and knowledge are important, though specifics vary**

- ❖ Workers need some understanding of core concepts including an understanding of the nanoscale (sub-atomic, atomic, molecular and supramolecular levels) and Quantum mechanics / quantum effects.
- ❖ Employers value interdisciplinary skills for nanotechnology workers.
- ❖ Key skill and knowledge requirements may vary from one industry to another.

## Supply- Side Research

- Environmental scan of nanotechnology related education in Arizona
- Study of nanotechnology degree and certificate programs

*Definition: Degrees with the term "nano" in the formal title.*

# Literature Review: Nanotechnology Higher Education in the U.S.

- National Center for Learning and Teaching Nanoscale Science and Engineering
  - “Big Ideas” on knowledge and skills needed for nanotechnology work
  - Database of degree and certificate programs
  - study of a sub-sample of programs found wide variations among programs (Wansom et. al., 2008)
- Stephan et al. (2007) scan of educational approaches
  - Most “nano” education occurs in labs
- SRI/Boeing case studies of several higher ed. programs
- Small Times survey of degree programs

# Common Approaches to Nanotechnology Education in U.S. Higher Education

Formal Approaches

Degree programs

Minor/concentration within traditional degree

Interdisciplinary student research (e.g. IGERT)

Modification of traditional degree content

Elective courses

Less Formal Approaches

# Degree Program Overview

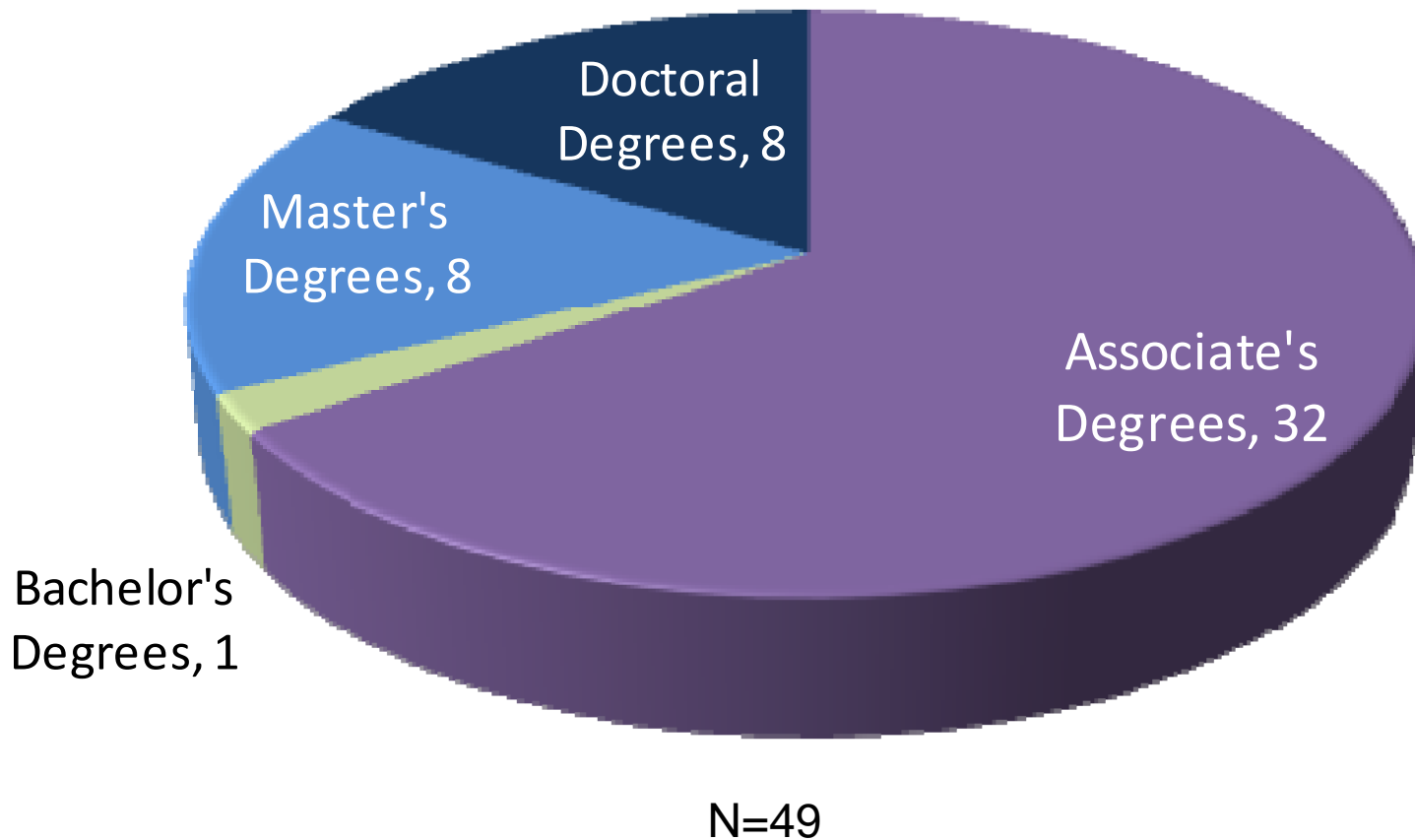
**Purpose:** To identify and describe the key characteristics of nanotechnology degree and certificate programs in the U.S.

- Programs identified from major national sources, targeted Internet searches, and referrals.

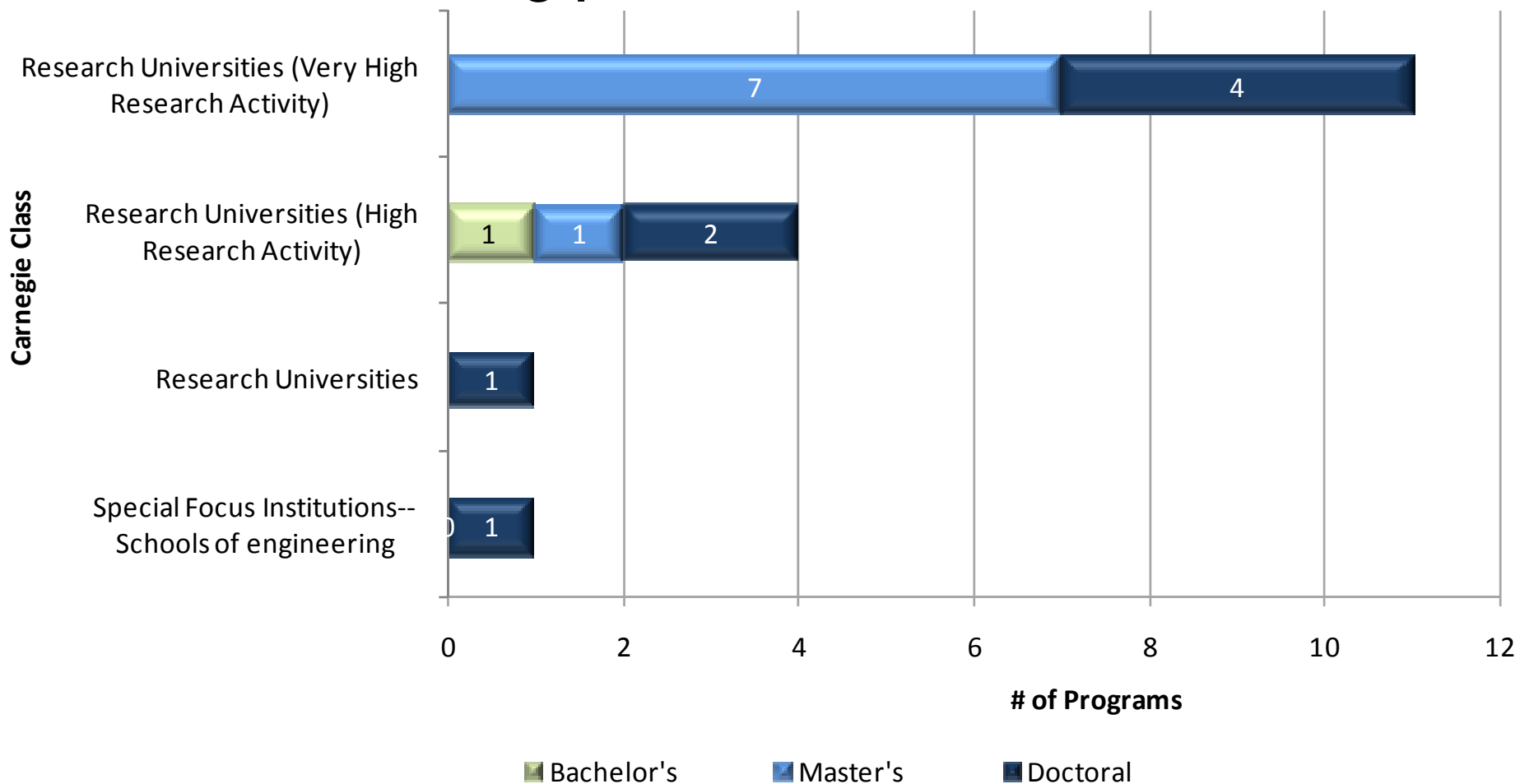
Nanotechnology Degree Program Lists	# Nanotechnology Degree Programs*
This Research	49
The Penn State University Center for Nanotechnology Education and Utilization	33
National Nanotechnology Initiative (NNI)	14
National Center for Learning and Teaching Nanoscale Science and Engineering (NCLT)	13
Small Times Survey 2007	9

- Interviews with faculty, administrators
- Analysis of key institution, program, and class-level data

# Degree Levels

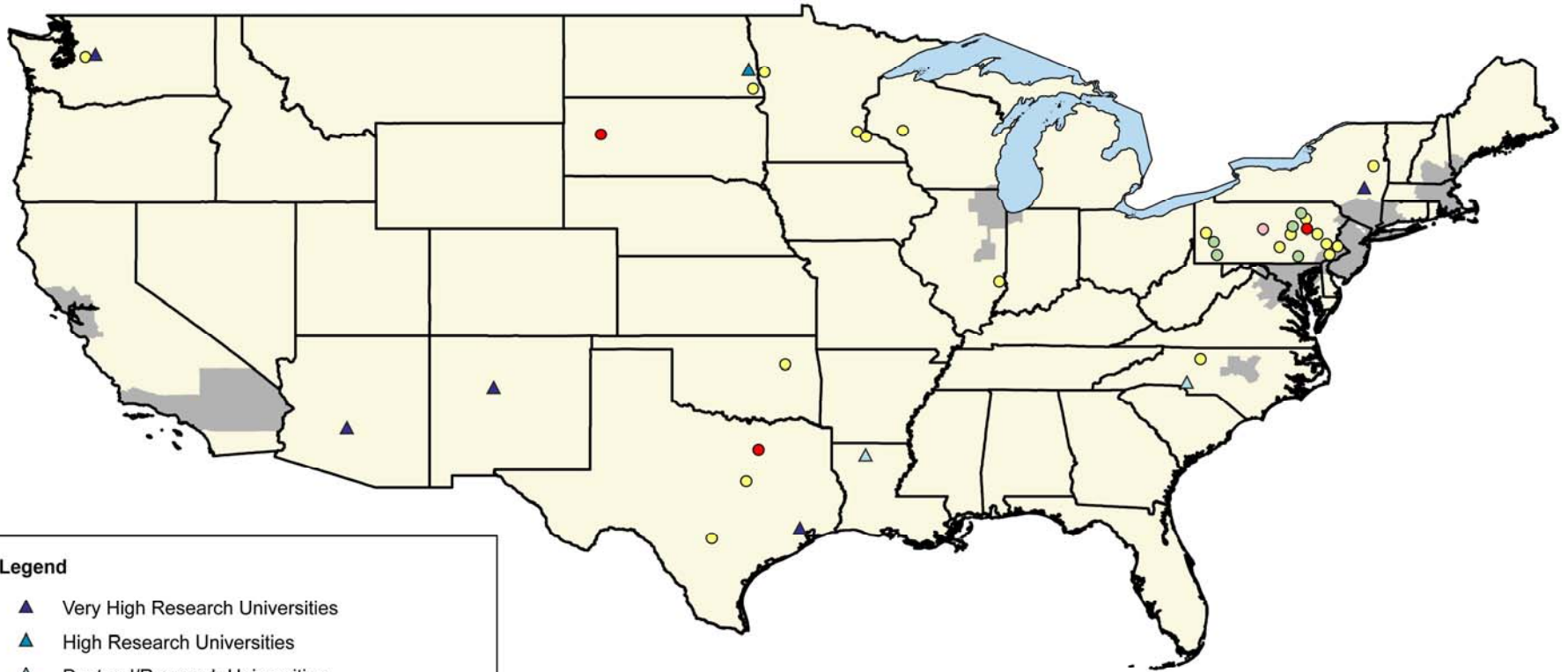


# Institution Type, BS and Above



N=17

# Geography



**Legend**

- ▲ Very High Research Universities
- ▲ High Research Universities
- ▲ Doctoral/Research Universities
- Master's Colleges
- Baccalaureate/Associate's Colleges
- Associate's-level Only Institutions
- Other

■ Top 10 MSAs by # of Nanotechnology Publications

# Interview Findings

## Employer involvement

- ❖ Level and type of employer involvement are inconsistent
- ❖ Workforce and economic development are key motivators for the creation of associate's degree programs in nanotechnology
- ❖ Reasons for creating other types of degrees are more diverse.

## Approach to interdisciplinarity of nano

- ❖ A shortage of qualified faculty, limited consensus on learning needs, and institutional factors contribute to varied approaches.

# Interview Findings (Cont'd)

## Partnerships

- ❖ Partnerships among related programs were common
- ❖ Inter-institutional partnerships appeared to be more common – or at least more commonly-cited, than intra-institutional partnerships

## Employment outcomes

- ❖ Little is known
- ❖ Some report success, others difficulty in placing graduates
- ❖ Associates degrees are more dependent on local labor market activity

# Conclusions

- The development of nanotechnology degree programs reflects the emerging nature of the technology itself.
- Need for nanotechnology-specific degrees in the current job market is not clear
- However, more education may be needed in:
  - common techniques/concepts (e.g. characterization, nanoscale concepts) and
  - Interdisciplinary aspects (including ethics/safety/legal)
- The variety of jobs affected by nanotechnology may indicate that moderate levels of nanotechnology-relevant content is needed for non-STEM majors (e.g. manufacturing, business/sales/marketing)

# “Nano” Degree-Granting Schools in U.S.

- Arizona State University
- Bucks County Community College
- Butler County Community College
- Chippewa Valley Technical College
- Dakota County Technical College
- Delaware County Community College
- Forsyth Technical Community College
- Harper College
- Harrisburg Area Community College
- Lehigh Carbon Community College
- Lock Haven University of Pennsylvania
- Louisiana Tech University
- Luzerne County Community College
- Minnesota State Community and Technical Collage
- Montgomery County Community College
- Normandale Community College
- North Dakota State College of Science
- North Dakota State University-Main Campus
- Northampton Community College
- Northwest Vista College
- Oklahoma State University
- Penn State Fayette Campus
- Penn State Hazleton Campus
- Penn State Wilkes-Barre
- Penn State York
- Pennsylvania State University Greater Allegheny
- Reading Area Community College
- Rice University
- Richland Community College (Dallas County C.C. District)
- Schenectady County Community College
- Seattle Community College-North Campus South Dakota School of Mines and Technology
- Texas State Technical College-Waco
- University of Albany, State University of New York University of New Mexico
- University of North Carolina Charlotte
- University of Washington-Seattle Campus
- Westmoreland County Community College

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