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Spatial Visualization:

A Promising Intervention for Promoting Student Equity

Wednesday April 27th, 2016 2:00-3:00pm

This material is based upon work supported by the National Science Foundation under Grant No. 0833076. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Co-Sponsors

NAPE National Alliance for Partnerships in Equity Education Foundation

WEPAN Women in Engineering ProActive Network

Engineering Inclusive Teaching Faculty Professional Development POWERED BY WEPAN

Engineering Plus UNIVERSITY OF COLORADO BOULDER

Goal

Compel and help:

YOU develop a **SV-Skills Training**

for **YOUR students**

Presenters

Susan Metz, M.S. ENGAGE PI, Executive Director of Diversity and Inclusion, Stevens Institute of Technology
Metz works at national and local levels to improve engineering education and to increase access, retention, and advancement of underrepresented groups in STEM fields. She is a founder of the Women in Engineering ProActive Network (WEPAN), has served on STEM policy advisory boards for organizations such as the National Science Foundation and National Academy of Engineering. Metz is a recipient of the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring and the Maria Mitchell Women in Science Award, and she is a Fellow of the Association for Women in Science.

Jacob Segil, Ph.D. Instructor, *Engineering Plus Program*, CU Boulder
Segil teaches mechatronic design, experimental design and statistics. He served a foundational role in developing the Spatial Visualization workshops at CU. Segil's research includes brain-machine interfaces, neural prosthetic devices and myoelectric control systems. Jacob earned his PhD in Mechanical Engineering from UC Boulder

Jacquelyn Sullivan, Ph.D. Co-Director, *Engineering Plus Program* and Co-Director, *Integrated Teaching & Learning Program*, CU Boulder
Sullivan works to integrate hands-on engineering throughout the K-16 learning experience and conducts engineering education research on equity of access and persistence. As CU's inaugural Associate Dean for Inclusive Excellence, Sullivan spearheaded design and launch of many initiatives to *broaden participation*—resulting in dramatic and lasting college-wide results. Sullivan founded ASEE's K-12 and PreCollege Engineering Division, is an ASEE Fellow and was awarded NAE's *Gordon Prize for Innovation in Engineering and Technology Education*. Jackie earned her PhD in environmental health physics and aquatic toxicology from Purdue University.

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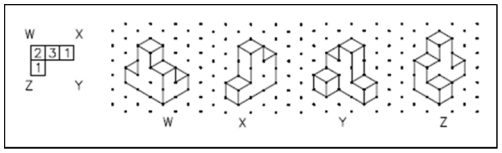
FACT: SV Critical to Engineering Success



FACT: SV Skills—Men Outperform Women

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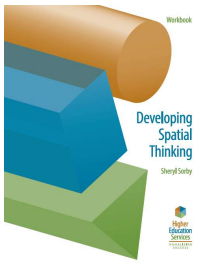
FACT: SV Skills Improve With Training

Curriculum & Snap Cubes: higheredservices.org



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Facts Compel Action

SV Skills Facts Summary:

- ✓Critical for Engineering success
- ✓Some subpopulations of students are less skilled
- ✓Improves with brief intervention

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Facts Compel Action

SV Skills Training

is an

Imperative for Retention

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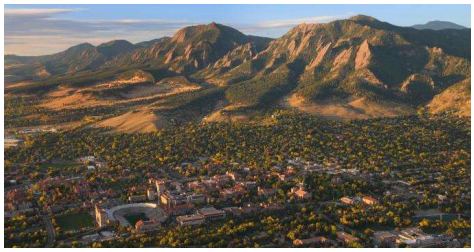
CU-Boulder SV Skills Intervention



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Change Foundation

Motivated by:

- ✓ Gender Equity
- ✓ WEPAN and ENGAGE Engineering
- ✓ Sheryl Sorby's work
- ✓ Evidence-driven (other and CU's)
- ✓ Intention to promote access, retention and performance
- ✓ SV skills critical to STEM success

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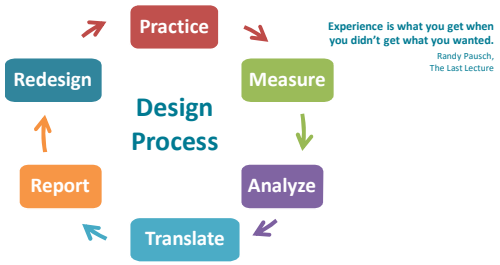
Intervention Design Process



Experience is what you get when you didn't get what you wanted.
Randy Pausch, The Last Lecture

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Purdue Spatial Visualization Test-Rotation (PSVT-R)

Two SV Measures
1) Performance = 0-30
2) Passing Rate ≥ 20

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83 % Pre SV Passing Rate

83%

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83 % Pre SV Passing Rate

Masks Inequity

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Gender Disparity Uncovered

Only **68%** of Women Passed

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International Disparity Uncovered

Only **61%** of International Students Passed

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Who *are* SV Skills Workshoppers?

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SV Workshopper Results: Passing Rate

0→91%

Overall Passing Rate

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SV Workshopper Results: Performance Gain

23% average performance gain benefitted **ALL** workshoppers

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Women: Before/After Workshop

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Men: Before/After Workshop

BEFORE
88%
Passing

AFTER
99%
Passing

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Internationals: Before/After Workshop

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Domestics: Before/After Workshop

BEFORE

85%

Passing

AFTER

99%

Passing

Closing the Gender Gap

99%

Post-workshop Passing Rate for

Men

(88% → 99%)

96%

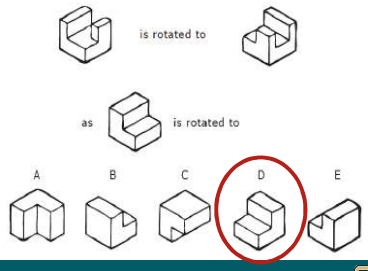
Post-workshop Passing Rate for

Women

(68% → 96%)

Our Spatial Visualization Workshop

Your Turn!



Communication with "Workshoppers"

Workshop Overview

1. Isometric drawing
2. Orthographic views
3. 1 and 2 axis rotations
4. Review and test

...for those needing more SV work:

5. Curved surfaces & inclined planes
6. Timed testing
7. Rotation strategies
8. Review and test

Workshop Activity Stations

Group

Individual

Peer-Teach

Computer

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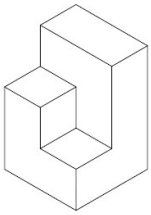
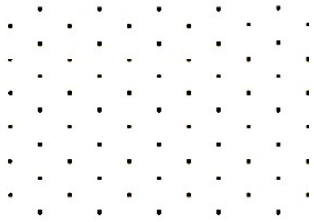
Example-Week 1: Isometric Drawing





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Station 1 – Group Block Relay

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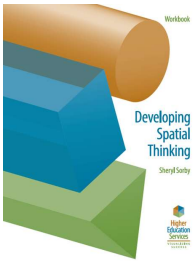
Station 2 – Individual Workbook Drill



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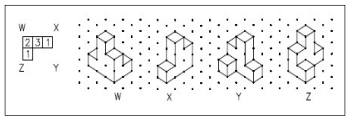
Station 3 - Peer Teach



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Station 4 - Computer Aided Visualization

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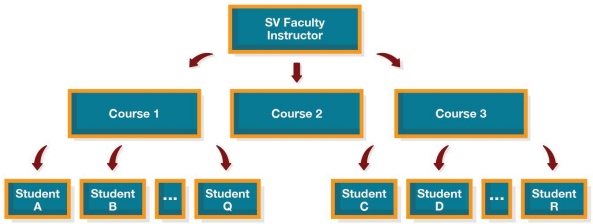
Total Annual Budget

$21,700/year

$20,000 Faculty (1 course credit)

CU Boulder SV Model Execution



SV Model Pros

No course curriculum changes
No ramping up by design course faculty
Reasonable time demand for students
Reasonable time demand for one faculty teaching credit (64 hr in workshops/year)
Scalable with addition of TAs ($1150 each)
Accountability ensured with 5% course grade

SV Model Cons

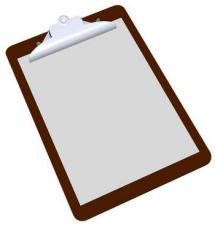
Requires commitment by design course faculty
Communication intensive
Lots of moving parts
Data management and integrity
Element of surprise for workshoppers (after hours requirement starts 2nd week of class)

Questions?

Your Turn Again: Poll 3

What do you perceive are YOUR barriers to IMPLEMENTATION of a spatial visualization intervention?

YOUR Next Step?



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Together we can engage all minds in engineering the future!

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Engineering Inclusive Teaching
Faculty Professional Development

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