Using Social Psychological Interventions to make STEM Classrooms Inclusive and Improve Learning

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• What are the learning objectives you have for your students?
• Help students develop expertise
Experts

- Adaptable and efficient
- Adaptable, but not efficient
- Neither efficient nor adaptable
- Efficient, but not adaptable

Motivation

Schwartz, Bransford, & Sears, 2005

Problem solving skills
Part 1

• What aspects of motivation do students struggle with?

• Why might different students have different motivations?

• Who are most at risk for having decreased motivation in your courses?
Solvay conference, 1927
Aguilar, Walton, & Wieman, 2014
Photograph by Ken Cole
Part 2

- Think about a student who has low motivation in your class.
- What are they concerned about?
- How does your student feel about their potential?
- Does your student feel accepted by their teacher or fellow students?
Motivational Resources

Belonging
Identity
Intelligence mindset
Self-efficacy
Interest
Achievement goals

safety and coping

Knowledge, Skills, & Behaviors

Efficient problem solving
Effective strategies
Robust understanding
Transfer of learning

requires some exposure to risk

resources - Knowledge, Skills, & Behaviors

requires some exposure to risk

resources - Motivational Resources

motivation - Belonging, Identity, Intelligence mindset, Self-efficacy, Interest, Achievement goals

safety and coping

knowledge, skills, behaviors - Efficient problem solving, Effective strategies, Robust understanding, Transfer of learning

requires some exposure to risk
Motivational Resources

- Belonging
- Identity
- Intelligence mindset
- Self-efficacy
- Interest
- Achievement goals

Knowledge, Skills, & Behaviors

- Efficient problem solving
- Effective strategies
- Robust understanding
- Transfer of learning

safety and coping

requires some exposure to risk
Do I belong here?  
Do people like me belong here?

Am I a Math person?  
Am I a Science person?  
Am I a Physics person?

I need to have a natural ability to succeed in a physics course.  
No matter who you are, you can change your intelligence in physics quite a lot.

If I study, I will do well on a physics test.  
If I wanted to, I could be good at doing physics research.
Stereotype threat

- Fear of confirming a negative stereotype about oneself
- Awareness of stereotypes is taxing, takes cognitive resources, hurts performance
- Stereotypes provide an attribution for poor performance
- Attributions to fixed, internal causes are demotivating
  “What’s the use in trying if people like me aren’t likely to be successful?”
ambiguity, uncertainty, 
derived from and 
activating stereotypes,
diminished performance,
lower sense of belonging, 
decreased self-efficacy / sense of identity, 
view intelligence as being fixed
Investigating student motivation in introductory physics courses

- Calculus-based physics courses ~1/3 female
- Gender differences in self-efficacy, belonging, identity, and intelligence mindset?
- Make a prediction about what you expect …
Self-efficacy

- I am often able to help my classmates with physics in the laboratory or in recitation.
- If I wanted to, I could be good at doing physics research.
- If I study, I will do well on a physics test.
- I get a sinking feeling when I think of trying to tackle difficult physics problems. (R)

![Graph showing changes in self-efficacy scores across different terms and genders.](image-url)
Mindset

- Anyone can become good at solving physics problems through hard work.

- Only a few specially qualified people are capable of really understanding physics.

- No matter who you are, you can change your intelligence in physics quite a lot.

- To really excel in physics, a person needs to have a natural ability in physics.

- If I spend a lot of time working on difficult physics problems, I can develop my intelligence in physics.

- If I make mistakes on physics assignments and exams, I think that maybe I’m just not smart enough to excel in physics.
Identity

- I see myself as a physics person.
- My family sees me as a physics person.
- My friends see me as a physics person.
- My physics instructor and/or TA sees me as a physics person.
Belonging

• I feel like I belong in this class.

• I feel like an outsider in this class.

• I feel comfortable in this class.

• I feel like I can be myself in this class.

• Sometimes I worry that I do not belong in this class.

• When I get a poor grade on a physics assignment or exam, I feel that maybe I don’t belong in a physics class.
Mindset, identity, and belonging

Calculus Based Physics Courses

Yes!

Mindset: d = 0.40
Identity: d = 0.52
Belonging: d = 0.58

out of 5

No!

Female
Male
I have pretty low self-confidence when I see how other people are so smart. Other people understand more than I do what is going on in the physics courses … I feel like I have to work a lot harder to understand something.

For physics I feel like I don’t connect things well enough when we get a hard problem, I don’t have enough confidence that I’ll be able to do it, it makes me nervous.

Some people have just natural ability for physics, and as hard as I work maybe I can become “OK” and can do those problems well enough and have adequate grade on exam but I don’t know if I can truly become fluent in it. Some people just have a natural talent for physics … but I can never do what they do.
I don’t feel comfortable in this class, physics gives me a sinking feeling, it kinda scares me. I compare myself to other people; it feels like I don’t belong in this physics course.

I don’t want to be in mechanical engineering anymore and physics has something to do with it. I don’t enjoy physics, math I enjoy and it is more involved in industrial engineering. Mechanical engineering is very physics heavy, and I just realized that it is not something I enjoy ….

Physics is so different for me than other courses. For example, I like understanding everything we talk about it chemistry. But, this is like the first time I struggled to understand things in physics. I don’t know how to connect things, concepts. It is really discouraging. Last semester, I thought I was going to fail, I thought I should switch out of engineering because I couldn’t really do well in Physics 1.
Professor Smith is concerned about the high failure rate in his introductory physics course. To encourage students to work harder, he starts the first class by telling the students how difficult the course is and that usually about 30% of the students fail. They must study hard, particularly if they think that their background preparation is weak.

Aguilar, Walton & Wieman, 2014
Professor Jones wants all her students in a class for potential majors to succeed, and she hopes to increase the diversity of physicists. So she schedules a weekly help session for students who might be having difficulty, and she personally invites all the women and minorities to attend.

Aguilar, Walton & Wieman, 2014
Professor Doe wants to boost students’ self-esteem and wants all of her students to feel welcome in the class. She makes sure to tell students that “everyone belongs here” and “you can DO it!” When a student asks a question or comments, she says it is a “great” question or comment, and is especially enthusiastic when that student is a women or underrepresented minority.

Aguilar, Walton & Wieman, 2014
## What **CAN** we do?

<table>
<thead>
<tr>
<th>Interventions and implementation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention type</strong></td>
<td><strong>Core psychological concern addressed</strong></td>
</tr>
<tr>
<td>Social belonging</td>
<td>When I feel excluded or disrespected in school or class, does it mean I don't belong there in general?</td>
</tr>
<tr>
<td>Growth mindset</td>
<td>When I struggle, does it mean I can't do it?</td>
</tr>
<tr>
<td>Values affirmation</td>
<td>In school, am I more than just a member of a group that is negatively stereotyped?</td>
</tr>
<tr>
<td>Critical feedback with assurance</td>
<td>When I receive critical feedback, does it mean that the teacher judges me or is biased against me?</td>
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</tbody>
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Aguilar, Walton & Wieman, 2014
What CAN we do?
Yeager and Walton, 2012; Walton, 2018

- We want to reduce ambiguity:
  - Students often aren’t aware how common their struggles are
  - Don’t minimize problems so much as acknowledge them as normal

- Attribute difficulties to universal, temporary causes
  - Universal: Everyone or almost everyone goes through it. It’s normal to feel anxious and uncertain.
  - Temporary: With time and effort, difficulties will be resolved

- By reducing anxiety, lessen likelihood of destructive attributions for adversity
Thank you