S041: A Guide to Commonly-Used Scales in Research on Math Student Success

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Introduction

- I study student perceptions of relearning in developmental math, or the experience of learning about mathematical content one has already tried to learn about before.
- Study is largely qualitative, but wanted to explore relationship between important factors in relearning experiences and existing constructs known to be critical to math student success in college.
Goal of Today’s Talk

- There are TONS of survey instruments to choose from for each construct
- Making the final decisions was difficult and time-consuming, no one should have to do this from scratch

In this talk, I will walk you through:
- Most common scales used for each construct
- How to decide among them
- Illustrate use of each scale with student data
Overview of Student Success Constructs

**Definition**: Purpose or goal for developing competence.

- **Mastery**—goal of developing competence relative to one’s prior level of competence.

- **Performance**—has goal of demonstrating competence relative to others (approach) or avoiding seeming incompetent relative to others (avoidance)

(Friedel, Cortina, Turner, & Midgley, 2010; Meece, Blumenfeld, & Hoyle, 1988; Midgley et al, 2000; Mesa, 2012)
Overview of Student Success Constructs

**Definition:** Perception of one’s ability to complete academic tasks.

- Definitions vary on whether this involves judgment of **proficiency** as well (i.e. can I complete the task, or can I complete it well?)
- Definitions vary on whether judgments are separated by how **difficult** the task is
  - Can I complete the most difficult material?
  - Can I compete basic material?

(Pintrich, Smith, Garcia, & McKeachie, 1993; Betz and Hackett, 1983; Hall and Ponton, 2005)
Overview of Student Success Constructs

**Definition:** Perception of self-image as mathematics learner. Different from self-efficacy because not specific to performance on a task.

- There are a million different conceptualizations of this but some agreement that:
  - Self-concept is multi-faceted not an overarching trait/disposition
    - General 'academic self-concept' not useful
  - Self-concept is a perceived relationship to a domain like math

See: Bandura (1986), Shavelson, Hubner & Stanton (1976) and Marsh, Byrne & Shavelson (1988) for details about commonalities across definitions
Overview of Student Success Constructs

• **Definition:** Perception that one decides to engage in behaviors that reduce opportunities for successful performance on tasks one considers important.

• Some debate about this definition, but any scale assessing self-handicapping needs to ask about students engaging in behaviors:
  - BEFORE an event takes place
  - With the intention of undermining performance

• Just asking about behaviors is not enough
  - Will you get enough sleep before an exam?
  - Do you stay up all night before an exam so if you don’t do well, that can be the reason?

• Related to attribution theory
  (Schwinger et al., 2014; Urdan & Midgley, 2001)
General Considerations for Survey Use

Any good survey should meet your standards for:

- Has it been validated with populations I’m interested in?
- Has it been used successfully in peer-reviewed studies?
- Is it free to use?
- Do I have to ask for permission from the authors to publish the results?
- Is the survey accessible to students? (language, technology requirements, etc.)
- How long would it take students to complete?
In my case, what was I interested in?

- **Who?** Developmental Math students

- **What?** Perceptions of relearning

- **Where/when?** While enrolled in a developmental math course

So, I would prefer a survey that:

- Is meant for use with **adults enrolled in college mathematics courses**

- Describes student perceptions of their own experience

- Asks questions specific to the math course a student is taking
Part 1: Achievement Goal Orientations

• Reasons for engaging in academic behavior and standards used to assess performance
• Meta analysis of achievement goals and self-efficacy (Huang, 2016) indicates two commonly-used measures for achievement goals: the Pattens of Adaptive Learning Scales (PALS) and the Achievement Goals Questionnaire (AGQ).

**PALS**
(Mastery) It’s important to me that I learn a lot of new concepts this semester.
(Performance Approach) It’s important to me that I look smart compared to others in my class.
(Performance Avoid) It’s important to me that I don’t look stupid in class.

**AGQ**
(Mastery approach) My aim is to completely master the material presented in this class.
(Mastery avoidance) My aim is to avoid learning less than I possibly could.
(Performance approach) My aim is to perform well relative to other students.
(Performance avoidance) My goal is to avoid performing poorly compared to others.
Part 1: Achievement Goal Orientations, overall

- **PALS (Midgley et al., 2000)**
  - Validity: Same correction with self-efficacy as AGQ, but three factor model more accepted by ed psych community
    - Good reliability (Cronbach’s alpha=.844 for mastery, .880 for performance aggregated together)
  - Access: free and publicly available manual for use; no credentials required to administer
  - Logistics: five point likert scale, shorter
- **AGQ (Elliot & Church, 1997; Elliot & Murayama, 2008)**
  - Validity: Good reliability (Cronbach’s alpha=.84 for mastery approach, =.88 for mastery avoidance, =.92 for performance approach, =.94 for performance avoidance) (Elliot and Murayama (2008)
  - Access: Unclear. Free to find fully online, but no manual
  - Logistics: five point likert scale, longer
Part 1: Achievement Goal Orientations

For my purposes, how do these stack up?

• PALS
  – Pro: Tested with 777 students enrolled in both remedial and college-level math courses (correct age, correct type of course) (Mesa, 2012)
  – Pro: is specific to the course the student is taking this semester
  – Cons: Not specific to mathematics.

• AGQ
  – Pro: Tested with 229 undergrads enrolled in intro-level psych course (correct age),
  – Pro: is specific to the course the student is taking that semester
  – Cons: reliabilities not measured with math students (wrong type of course)
  – Cons: Usefulness of distinguishing between mastery avoidance and performance avoidance not yet been supported (Huang, 2016)
Part 1: Achievement Goal Orientations, Example

• Choice: Goal Orientations Subscales of the PALS
• Example of use of scale for student perceptions of relearning (honors student in I.A.):
  • “K: The statement was, it's important to me that I thoroughly understand my classwork and you strongly agreed with that. So could you tell me more about like why you would strongly agree with that goal?
  • S2S6: Yeah, because honestly it's what we've been talking about for like the past hour. I want to be able to really understand why I'm getting the answers that I'm getting, not just going through the motions. I wanna understand why I'm getting the answers so I can move forward [in this class].”
Part 2: Self-efficacy

• Reasons for engaging in academic behavior and standards used to assess performance
• Meta analysis of achievement goals and self-efficacy (Huang, 2016) indicates two commonly-used measures for self-efficacy: the Pattens of Adaptive Learning Scales (PALS) and the Motivated Strategies for Learning Questionnaire (MSLQ)
• Mathematics Self-Efficacy Scale (MSES) has been used by Hall and Ponton (2005) to describe self-efficacy of Intermediate Algebra and Calculus students.

PALS
I’m certain I can master the skills taught in class this semester.
I can do almost all the work in class if I don’t give up.
I can do even the hardest work in class if I try.

MSLQ
I’m confident I can understand the basic concepts taught in this course.
I’m confident I can understand the most complex material presented by the instructor in this course.
I’m confident I can do an excellent job on the assignments and tests in this course.

MSES
Indicate how much confidence you have that you could successfully accomplish each of these tasks by selecting the number according to the following 10-point confidence scale:
Estimate your grocery bill in your head as you pick up items.
Rate college courses according to confidence you could complete with a final grade of “A” or “B”.
Part 2: Self-efficacy

- **PALS (Midgley et al., 2000)**
  - Validity: Cronbach’s alpha = .831 with community college students in remedial and college level math courses; Theoretical structure not as aligned with ed psych literature
  - Access: same as before. Free to use, manual available
  - Logistics: same as before

- **MSLQ (Pintrich, Smith, Garcia, & McKeachie, 1993)**
  - Validity: good reliability (Cronbach’s alpha = .93 for self-efficacy)
    - Pintrich, Smith, Garcia, & McKeachie (1993)
  - Access: manual and items freely available
  - Logistics: good. 8 questions. 7-point likert scale

- **MSES (Betz & Hackett, 1993)**
  - Validity: Good reliability (Cronbach’s alpha = .90 for everyday task, = .93 courses, = .92 problems, = .95 for the full scale)
  - Access: **Not free to use.**
  - Logistics: Very long (involves problem solving), 9-point likert scale
Part 2: Self-efficacy

For my purposes, how do these stack up?

- **PALS**
  - Pros/cons: mostly the same as with achievement goals (right population, specific to the course, not specific to mathematics)
  - But, unclear theoretical structure

- **MSLQ**
  - Pro: Designed for college students (right age)
  - Pro: is specific to the course the student is taking that semester, some citations in math ed lit
  - Con: Reliability **not** measured with math students (wrong type of course), subscale has great reliability, but overall questionnaire is not widely regarded as reliable

- **MSES**
  - Pro: Used with college students (right age), some citations in math ed lit, use in dev math lit
  - Con: Reliability **not** measured with math students because scale is not specific to course student is taking
  - Con: ‘Everyday math tasks’ sometimes overlap with elementary/intermediate algebra tasks
Part 2: Self-efficacy, Example

- Choice: MSLQ (motivated strategies for learning questionnaire)
- Example of use of scale for student perceptions of relearning (Student in IA):
  - “K: This is I'm certain I can understand the most difficult material presented in this course. And again, you felt neutral about that, so could you tell me a little bit more about that?
  - S2S8: So this course, like from what I've learned so far, it's mostly like a refresher. Like I've already learned it. So I'm not really sure like what the most difficult topic would be, whether we have gone over it in the past or not, so I think if it was something that we went over it would be a little bit easier to understand just 'cause I have a basic knowledge of how it would go.
  - Versus like if it's something completely new then I think I would have a bit more trouble trying to and be slower for me to understand.”
[scored in 40s on exam 1]
Part 3: Math self-concept

- Perception of self-image as mathematics learner
- No meta-analysis that lists most common instruments (Huang, 2011). Million different conceptualizations → Million different scales
- Only scale consistently referenced is subscale of Academic Self-Description Questionnaire III (SDQ III)
- Also interested in Mesa (2012) adaptation of Views about Mathematics Survey (VAMS)

**SDQ III**

I find many mathematical problems interesting and challenging.

I have hesitated to take courses that involve mathematics.

I have generally done better in mathematics courses than other courses

**VAMS**

For me, solving a problem that involves mathematical reasoning is an enjoyable experience.

When I experience a difficulty while studying mathematics, I give up trying.

For me, solving a problem that requires mathematical reasoning is a frustrating experience
Part 3: Math self-concept

• SDQ III (Marsh & O’Neill, 1984)
  – Validity: good reliability (Cronbach’s alpha= .95 for the math subscale with undergrads in psychology or education courses) published in AERJ
  – Access: full scale (all subscales) available, manual can be found in libraries
  – Logistics: short. 8 point likert scale items

• VAMS (Mesa 2012 adaptation)
  – Validity: Has only okay reliability (Cronbach’s alpha=.767), unclear how adapted items were chosen from original VAMS instrument, difficult to relate findings using scale to other work of Carlson et al. using the scales
    • Original VAMS is about views about mathematics as a subject/domain not student relationship to mathematics
  – Access: unclear. I was able to view on request of author
  – Logistics: short, adapted to be 5 point likert scale, was 8 point scale
Part 3: Math self-concept

For my purposes, how do these stack up?

- **SDQ III**
  - Pro: designed for and validated with college students (right age)
  - Pro: specific to mathematics (right course)
  - Cons: None

- **VAMS (Mesa 2012 adaptation)**
  - Pro: Tested with 777 students enrolled in both remedial and college-level math courses (correct age, correct type of course)
  - Pro: Specific to math courses in particular
  - Original VAMS used in math ed lit, but has theoretical issues
  - Cons: Not great reliability means interpretations of data are iffy
Part 3: Math self-concept, Example

• Choice: SDQ III (Academic Self-Description Questionnaire III)
• Example of use of scale for student perceptions of relearning (student taking I.A.):
  • “K: And then last one was just simply. I'm quite good at mathematics and and you said that that was false, so could you tell me more about that?
  • S2S5: Like the people like who I went to school with like if you were good at math, it would instantly click. Like that's how we like decided whether or not someone was good at math, so it takes a while for things to like process for me sometimes, so I don't think that's like good in math class. I feel like, especially when it's a test with a lot of problems that require you doing work, it's not good that you take a while to think about it.”
Part 4: Self-handicapping Strategies

- Intentional self-sabotage
- Meta-analysis (Schwinger et al., 2014) states two most commonly-used instruments are subscale of the PALS and Self-handicapping Scale (SHS)

### PALS

Some students fool around the night before a test. Then if they don’t do well, they can say that is the reason. Would you agree that this statement applies to you?

Some students purposely don’t try hard in class. Then if they don’t do well, they can say it is because they didn’t try. Would you agree that this statement applies to you?

### SHS

I suppose I feel “under the weather” more often than most people.

Before I sign up for a course or engage in any important activity, I make sure I have the proper preparation or background.

I tend to get very anxious before an exam or “performance.”
Part 4: Self-handicapping Strategies

- **PALS** (Midgley & Urdan, 1995; Urdan et al., 1998)
  - Validity: Good reliability as in Mesa (2012) (Cronbach’s alpha=.847), tested with community college student in remedial and college-level math
    - Follows agreed theoretical approach: behavior + intention to reduce capacity to perform
  - Access: same. free and publicly available manual for use; no credentials required to administer
  - Logistics: different format than other PALS questions but same 5 point likert scale

- **SHS** (Jones & Rhodewalt, 1982)
  - Validity: Unclear reliability. Original version claims reliability confirmed with nondescript “large group” (cronbach’s alpha=.79). But reliability measured in another study was only .74
    - Does NOT follow agreed theoretical approach. This is about behaviors that COULD potentially lead to self-handicapping
    - Not tied to a course event
  - Access: Unclear. There are multiple versions of instrument.
  - Logistics: Very long. 24-27 items depending on version you find
Part 4: Self-handicapping Strategies

For my purposes, how do these stack up?

- **PALS**
  - Pros/cons: same as before. Several citations in math ed literature.

- **SHS**
  - Pro: ?
  - Con: Unclear which population participated in reliability measures (wrong population?)
  - Con: Theoretically unsound
  - Good for those interested in counseling/social psych, not so much for ed psych
Part 4: Self-handicapping Strategies, Example

- **Choice**: Subscale of Patterns of Adaptive Learning Scales (PALS) also named the Academic Self-handicapping Scale (ASHS)
- **Example of use of scale for student perceptions of relearning**: (retaking IA)
- **K**: Some people purposely don't try hard so then if they don't do well, they can say it's because they didn't try.
- **S2S7**: Yeah, I wouldn't do that because like I'm gonna like give it my all every time that I take a quiz like I'm not going to make excuses because no one's gonna care or listen to them. So I'm gonna try my best for everything.
- **K**: Do you think that you would have agreed with that in elementary or intermediate algebra these past times?
- **S2S7**: Honestly, no. I had a different attitude in those classes just because of like how they were going. Yeah, and I kind of just wanted to like cheat on the exams and everything and I was just like I don't care. I don't want to do this.”
Review

- When looking for survey instruments, there are two types of considerations:
  1. What makes a survey good in general?
  2. What makes a survey good for my purposes?

- Developmental Math students
  - Who?
- Perceptions of relearning
  - What?
- While enrolled in a developmental math course
  - Where/when?
Thank you!

- Please contact me at kristen.amman@gse.rutgers.edu with any questions.