



Conceptualising and measuring persistence in mathematics lessons

Dr Ariel Lindorff
Associate Professor of Education
University of Oxford

Outline

1. My journey to this topic
2. A story of poor measurement
3. Concept of persistence
4. Why is persistence important?
5. How has it been measured?
6. Reflections towards future research



My journey to this topic



- Routes to (and through) academic scholarship



A straight and narrow road...



Or many rivers winding towards the sea?

Equity and effectiveness in mathematics education



- Equity

- ...of outcomes
- ...of opportunity
- Based on individual characteristics
 - E.g. gender, ethnic group, socioeconomic status
- Based on individual needs
 - E.g. visible and invisible special educational needs, formally identified or not
- Based on context
 - E.g. neighbourhood, region, digital divide/access

- Effectiveness

- What works?
 - *For whom?*
 - *When?*
 - *How?*
 - *Where?*
 - *Why?*

Classroom practice

- Using classroom observations, often both structured and open-ended
- Systematic/detailed understandings of what teachers (and students) do, how teachers interact with students, how this varies, and what explains this variation
- Relationships between what teachers do in the classroom and student outcomes
 - Achievement/attainment
 - Engagement, motivation, self-efficacy
 - Aspirations, academic self-concept



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e.g. Lindorff, Jentsch, Kaiser, Walkington & Sammons, 2020

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e.g. Ingram & Lindorff, 2020



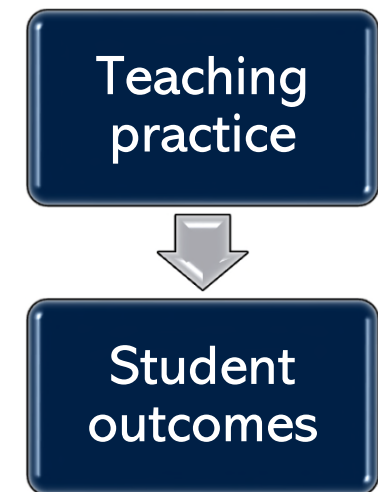
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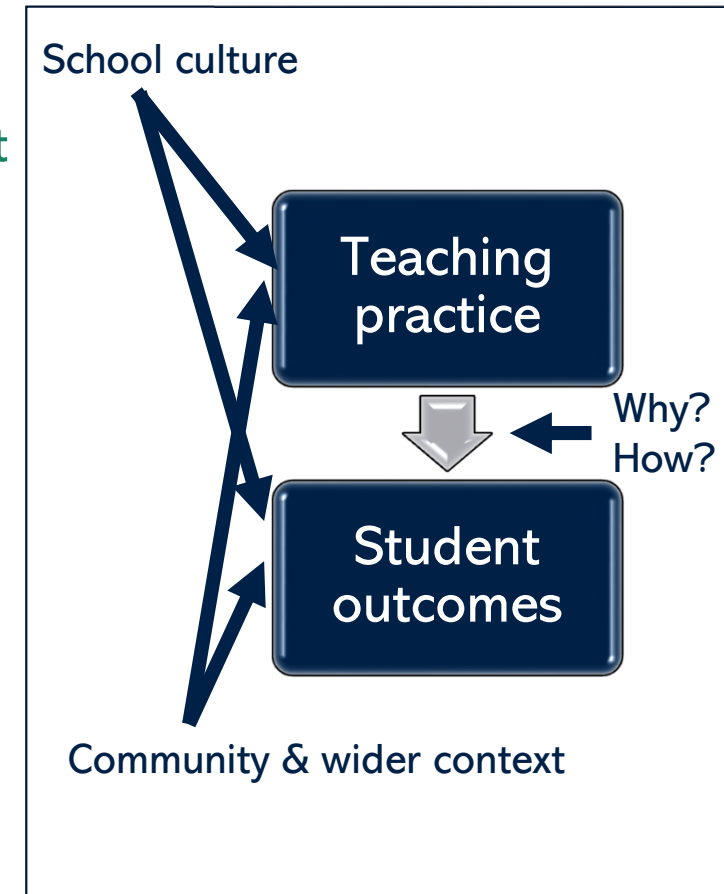


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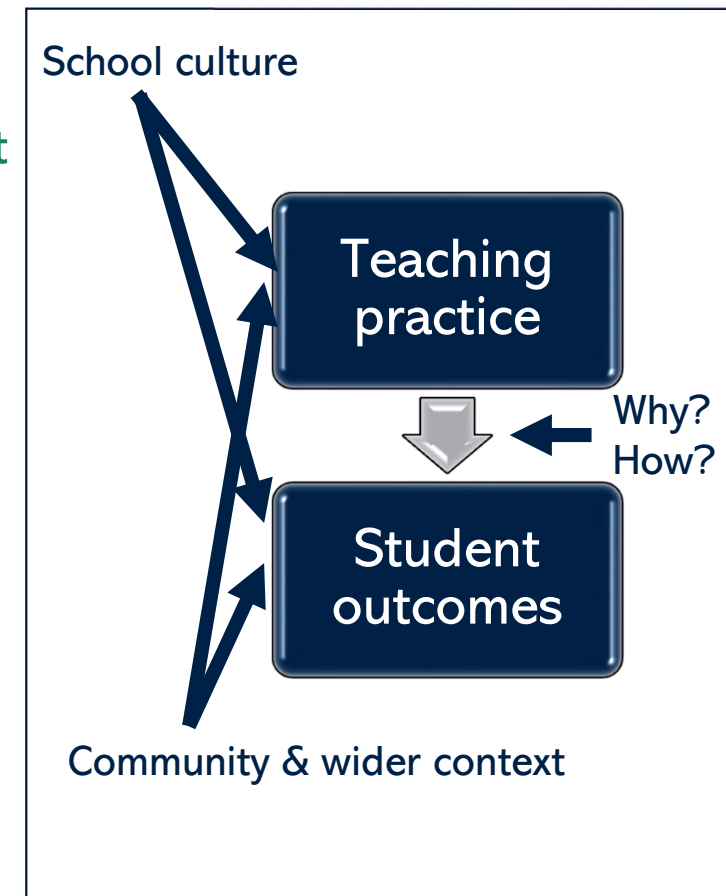


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- Just one part of a complex system, but an important part!
- The interest in *persistence* discussed here arose from one such study



TALIS Video Study 2018



- Also known as “Global Teaching Insights”
 - <https://www.oecd.org/education/school/global-teaching-insights.htm>
- Eight participating countries/economies, each with 38-103 schools and 50-103 teachers participating
- All at a similar age/grade level (~15), all focused on quadratic equations
- Two-stage, probability sampling design (schools and teachers)
- At least 50% of a class had to consent to participate
- Data: Video-recorded lessons, lesson artefacts (e.g. lesson plans, handouts, powerpoint slides), student pre- and post-unit test and questionnaire, teacher pre- and post-unit questionnaires, teaching logs (describing unit)
- National report for England (Ingram & Lindorff, 2020): https://assets.publishing.service.gov.uk/media/617194cc8fa8f52983494940/TALIS_video_study_country_report.pdf
- International report (OECD, 2020a): <https://doi.org/10.1787/20d6f36b-en>

TALIS Video Study 2018



- University of Oxford “Master Rater” team: Jenni Ingram, Ariel Lindorff, Pamela Sammons
- As “Master Rater for Videos” I led recruitment, training, and managed the rating process for 2 teams:
 - 9 raters for Components (a *high-inference* observation tool)
 - 10 raters for Indicators (a *low-inference* observation tool)
- 85 teachers (from 78 schools, with 2024 students), 2 lessons each, rated by 2 raters each in segments of:
 - 16 minutes for Components
 - 8 minutes for Indicators

Large sample, multiple raters per video, multiple videos per teacher, measures of student pre- and post-unit mathematics knowledge/skills and affect...rigorous design, right?

Persistence in TALIS Video 2018



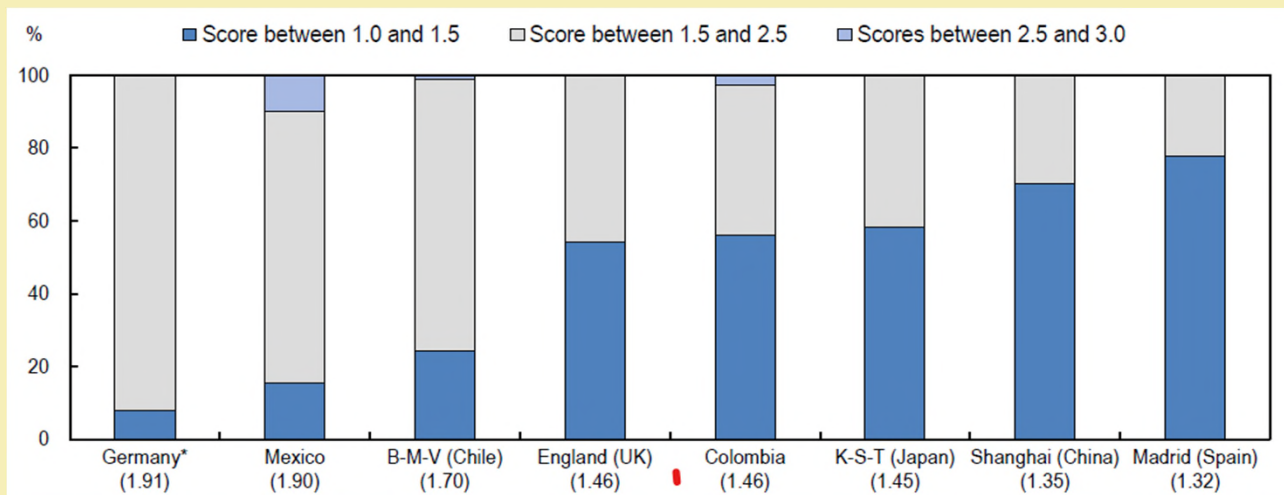
- Framed as a low-inference *Indicator*
- Located within the domain of *Social-Emotional Support*

Persistence	1	2	3	4
Student(s) persist through errors or mathematical struggles with the teacher's support.	<p>Student(s) did not make errors or engage in mathematical struggle.</p> <p>OR</p> <p>Student(s) are not aware they have made an error or are engaged in a mathematical struggle.</p>	<p>Student(s) are aware they have made an error or are engaged in a mathematical struggle.</p> <p>AND</p> <p>Mathematical errors or struggles are either ignored or briefly and/or superficially addressed.</p>	<p>Student(s) are aware they have made an error or are engaged in a mathematical struggle.</p> <p>AND</p> <p>Student(s) persist through mathematical errors or struggles in a moderate length and/or depth with the teacher's support.</p>	<p>Student(s) are aware they have made an error or are engaged in a mathematical struggle.</p> <p>AND</p> <p>Student(s) persist through mathematical errors or struggles in significant length and/or depth with the teacher's support.</p>

(OECD, 2020b)

- Already you may notice some possible measurement issues...?

Persistence in TALIS Video 2018 (continued)



(OECD, 2020a)

- Very few instances of classrooms/lessons with high persistence
- Low country averages overall (below the midpoint of the 4-point scale)
- Little evidence of a significant, substantial relationship to post-test score

This seems counter-intuitive. Consequence of lacking conceptualisation, leading to poor measurement?

What is persistence?



- Oxford English Dictionary:
 - *The action or fact of persisting in a particular state, opinion, purpose, or course of action, esp. despite opposition, setback, or failure; the quality or virtue of being persistent.*
 - *Continued or prolonged existence or occurrence; duration; continuance.*
- Specifically in mathematics education:
 - “Effort in the face of challenge”, “primarily concerns short-term goals” but can be cumulative longer term (DiNapoli, 2023)
 - Typically problem-solving, but could be a different type of mathematical task
 - Can also be thought of in terms of productive struggle or “productive failure” (Kapur, 2010)



- Unhelpfully, used in different ways:
 - Persistence in problem solving or a specific mathematical task (**this is our focus today**)
 - Persistence across lessons within a unit/year/phase
 - Persistence over the long term in mathematics/STEM major or career choice (e.g. Harden et al., 2020)
- Unhelpfully, sometimes used interchangeably with other words, or perhaps unhelpfully differentiated from them
 - E.g. Perseverance: Persistence plus strategy & adaptation? (DiNapoli, 2023)
 - E.g. Grit, longer term commitment to ambitions/goals (Duckworth et al., 2009)

What is persistence (continued)



- Even where the term is not used, it may be meant
 - E.g. Boaler et al., 2021
 - Part of a “mathematical mindset” approach to teaching
 - i.e. part of a “growth mindset”
 - Implies connections to beliefs and to teaching approaches
 - E.g. Schoenfeld, 2022
 - Related to/part of “metacognitive skills” that may be taught
 - Picked up as part of *cognitive demand* in the Teaching for Robust Understanding framework (Schoenfeld, 2016)
 - *Related* to equity (who gets what opportunities for challenge)
- SO: Although we don’t have a unified conceptualisation or use the term consistently, we seem to agree that there is something about students’ persistence that is relevant to their mathematical learning

Why is persistence important?



- Intuitively, perhaps this seems obvious!

The importance of persistence in mathematics

BrainQuake - Follow
4 min read · Jun 13, 2020

2



Hae-Sin Thomas, the CEO of Education for Change Public Schools in Oak
important of persistence in doing math. Video by Brai

Mathematical problem solving requires several import them: knowledge of mathematical concepts, rules and mathematical procedures; adequate understanding of concepts; mathematical creativity; and, as the teacher noted, persistence.

STUDENT ENGAGEMENT

Encouraging Persistence in Math

Weekly open-ended math tasks can pique students' interest, lead them to take risks and develop a growth mindset.

By [Solenne Abaziou](#)
May 24, 2018



Students often struggle with persistence—they're uncomfortable with the idea of trying a solution if they're not confident that it will yield the desired results, which leads them to refuse to take risks.

October 30, 2019

How Can We Promote Persistence in Math?

Three educators discuss how EDC's curricula promote mathematics learning.

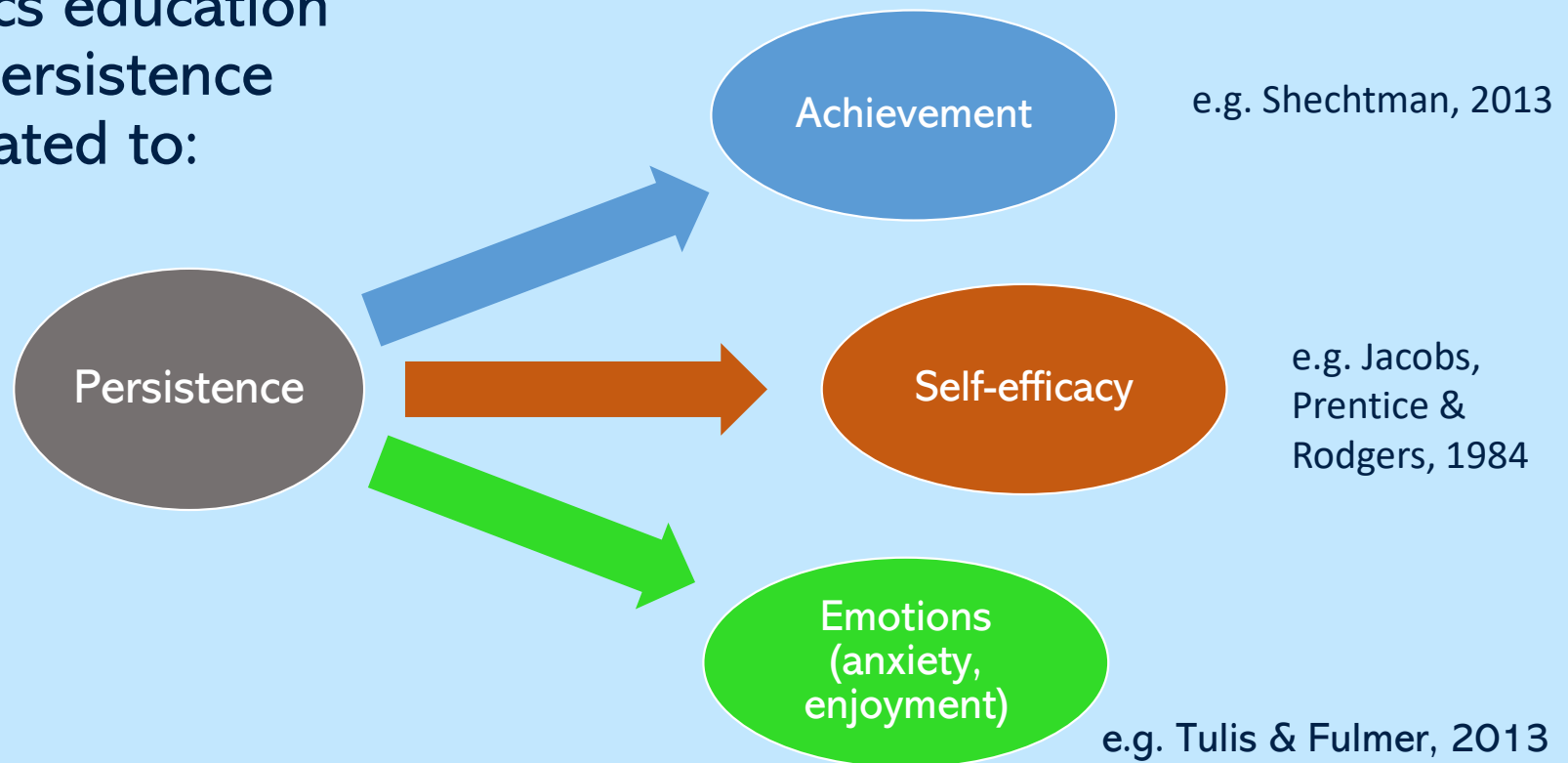


As a high school senior in 1986, Stephanie Ragucci took "not one, not two, but three" mathematics courses with EDC's [Al Cuoco](#), who was then a teacher at Woburn High School. She says that Cuoco's classes had a particular style that she found engaging.

"He would present a problem, let us wrestle with it for a while," she says. "It

Why is persistence important? (2)

- Previous research in mathematics education suggests persistence may be related to:



Why is persistence important? (3)



- Previous research in mathematics education also indicates that students may vary in their persistence (e.g. Hori & Fujii, 2021; Montague & Applegate, 2000; Stanic & Hart, 1995)
 - By gender?
 - By ethnic group?
 - By special educational needs identification?
 - By socioeconomic status?
 - By ICT access/use?
- And considers how teaching impacts students' persistence (e.g. Ekmekci & Serrano, 2022)
- **This suggests relevant equity and effectiveness issues in need of attention**

How has persistence been measured?



- Student self-report
 - Multi-dimensional, validated measures (e.g. Constantin, Holman & Hojbota, 2011)

Dimensions and Persistence Scale ¹ Items
Short-term Pursuits
I have a good capacity to focus on daily tasks. Once I decide to do something, I am like a bulldog: I don't give up until I reach the goal. I continue a difficult task even when the others have already given up on it. The more difficult a task is, the more determined I am to finish it.
Long-term Pursuits
I remain motivated even in activities that spread on several months. Long term purposes motivate me to surmount day to day difficulties. I purposefully pursue the achievement of the projects that I believe in. I keep on investing time and effort in ideas and projects that require years of work and patience.
Recurrence of Unattained Pursuits
I often come up with new ideas on an older problem or project. From time to time I imagine ways to use opportunities that I have given up. Even though it doesn't matter anymore, I keep thinking of personal aims that I had to give up. I often find myself thinking about older initiatives that I had abandoned.

¹ Participants rated items on a 5-point scale from 1 = "in a very low degree" to 5 = "in a very high degree".

- Or focused on time or task completion (e.g. Tulis & Fulmer, 2013)

How has persistence been measured? (Student self-report)



- *Strengths*

- Possible to be quite comprehensive
- Captures dimensions of the concept
- Possible to have individual and class measure (based on individual report)
- Possible to access internal aspects (e.g. whether/how much challenge a student encountered)
- May be relatively low cost (e.g. online survey)

- *Weaknesses*

- Potentially time-consuming or disruptive
- Self-report may not be accurate or reliable
- Variations in interpretation of items

How has persistence been measured?



- Classroom observation
 - Time spent on a task, could be literally timed (e.g. Fisher, 1996) or estimated with quasi-numeric categories
 - Completion of tasks/subtasks (e.g. Multon, Brown & Lent, 1991)
 - Evidence of challenge and response (e.g. OECD, 2020a)
 - Opportunity to engage in “productive struggle” (e.g. Schoenfeld, 2016; 2020)
 - May involve time-sampling of groups of students or individual students
 - May involve frequency of certain events across a lesson/observation
 - May involve high-inference holistic judgment

How has persistence been measured? (Observation)



• *Strengths*

- More reliable than self-report (sometimes...)
- Able to focus on the class level
- Easier to achieve consistency of interpretation across units (classes, teachers, topics)

• *Weaknesses*

- Impractical to use this approach for full coverage of individual students
- Only indirect indicators of struggle
- Time/completion may not represent the construct well
- Holistic judgment may be unreliable
- Robust observations can be time-consuming and costly

How could we measure persistence?

- Multiple perspectives?



- Complementary benefits and challenges
- Indicators internal/external to students (combine low/high inference?)
- Possible to build on existing measures, refine and combine





Where might this lead us?

- Better basis for comparisons so we can learn from one another
- Better understanding of variation (across students and classes)
- Better basis for understanding how aspects of practice link with student persistence, which aspects of practice matter and how
- Better basis for understanding how persistence supports, and perhaps bridges, equity gaps in academic and affective student outcomes

Thank you for listening!

Questions?

Contact:

Ariel.Lindorff@education.ox.ac.uk



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