Week 6 Video 1

Visualization

Learning Curves

Visualization

- Displaying information in a meaningful fashion

Visualization Should… (Tufte, 1983)

- Show the data
- Induce the viewer to think about the substance
- Avoid distorting what the data have to say
- Make large data sets coherent
- Encourage the eye to compare different pieces of data
- Reveal the data at several levels
- (And other stuff too)

Visualization

- A big area
- Worthy of a course in its own right

- Rather than discussing standard visualizations

- I'll discuss a few visualizations that are particularly important with educational data

Learning Curves

- One of the most important visualizations in education
- Briefly discussed in Week 4
- I'll go into more depth today

The Classic Learning Curve

Assumptions

- The student is practicing the same skill several times in (approximately) the same fashion

- Completing a physics problem set
- Reading the same word in several stories
- Learning to complete an assembly line procedure
  - Early application! (Crossman, 1959)

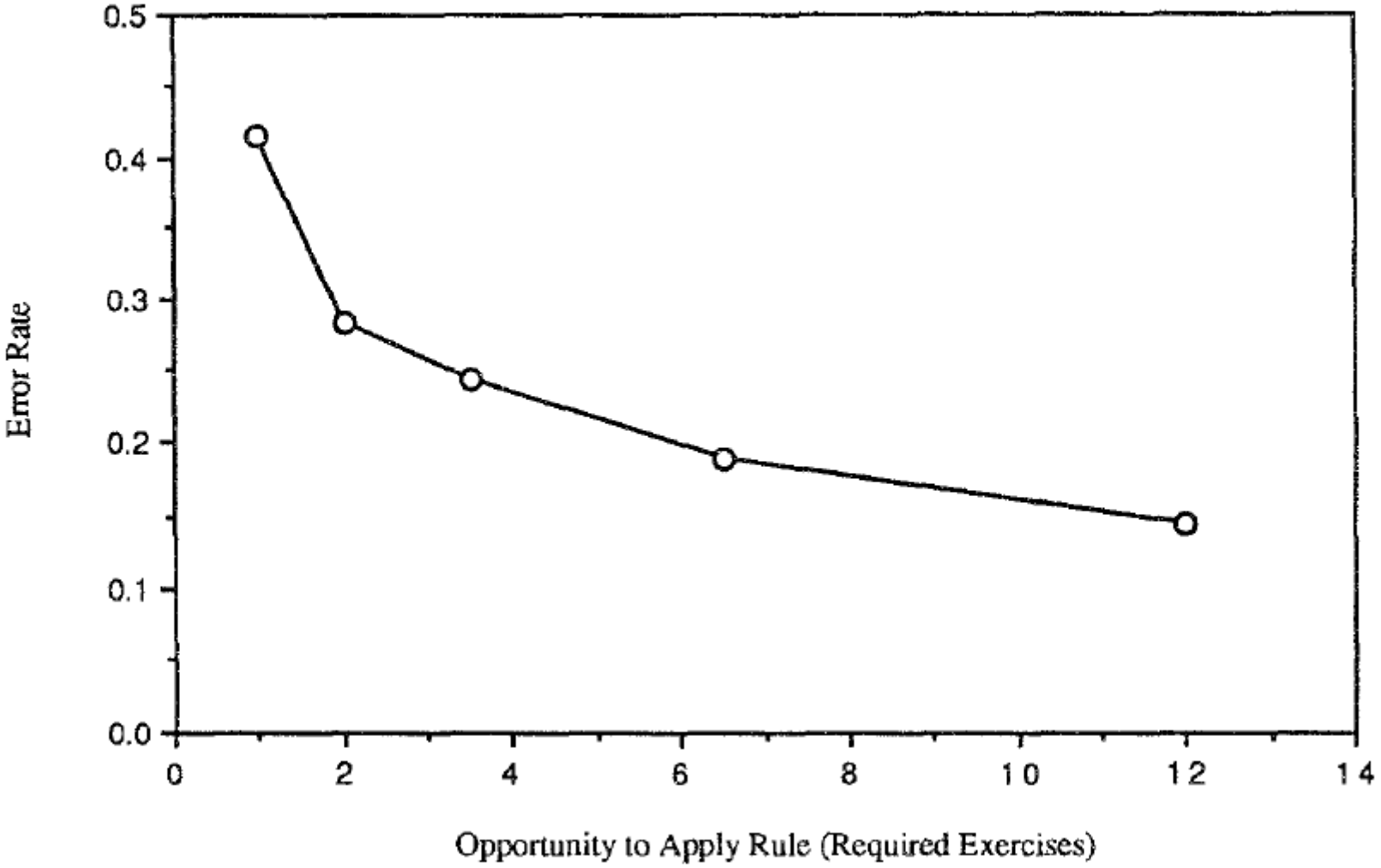
Assumptions

- Similar methods and considerations apply to situations where the student is recalling the same knowledge several times

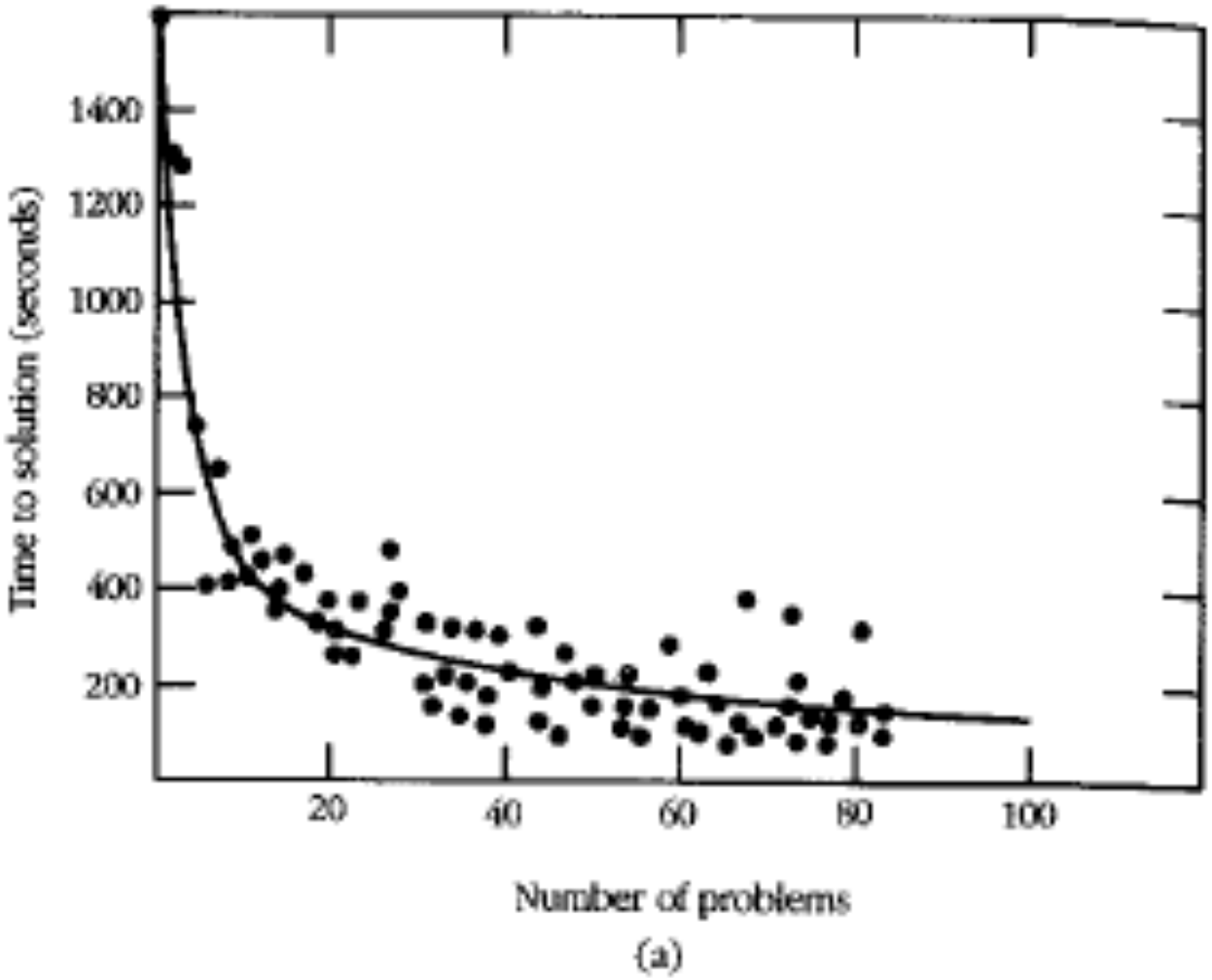
Assumptions

- We have some way to measure student performance over time
  - Speed or accuracy

Learning LISP programming in the LISP Tutor (Corbett & Anderson, 1995)



Learning in Cognitive Tutor Geometry (Ritter et al., 2007)



A certain characteristic pattern

Power Law of Learning*

- Performance (both speed and accuracy) improves with a power function

* -- May actually be an exponential function rather than a power function (Heathcote, Brown, & Mewhort, 2000)

Called Power Law

- Because speed and accuracy both follow a power curve
- Radical improvement at first which slows over time towards an asymptote
- Passing the asymptote usually involves developing entirely new strategy

Passing the Asymptote

- Famous example: Fosbury Flop

- http://www.youtube.com/watch?v=Id4W6VA0uLc

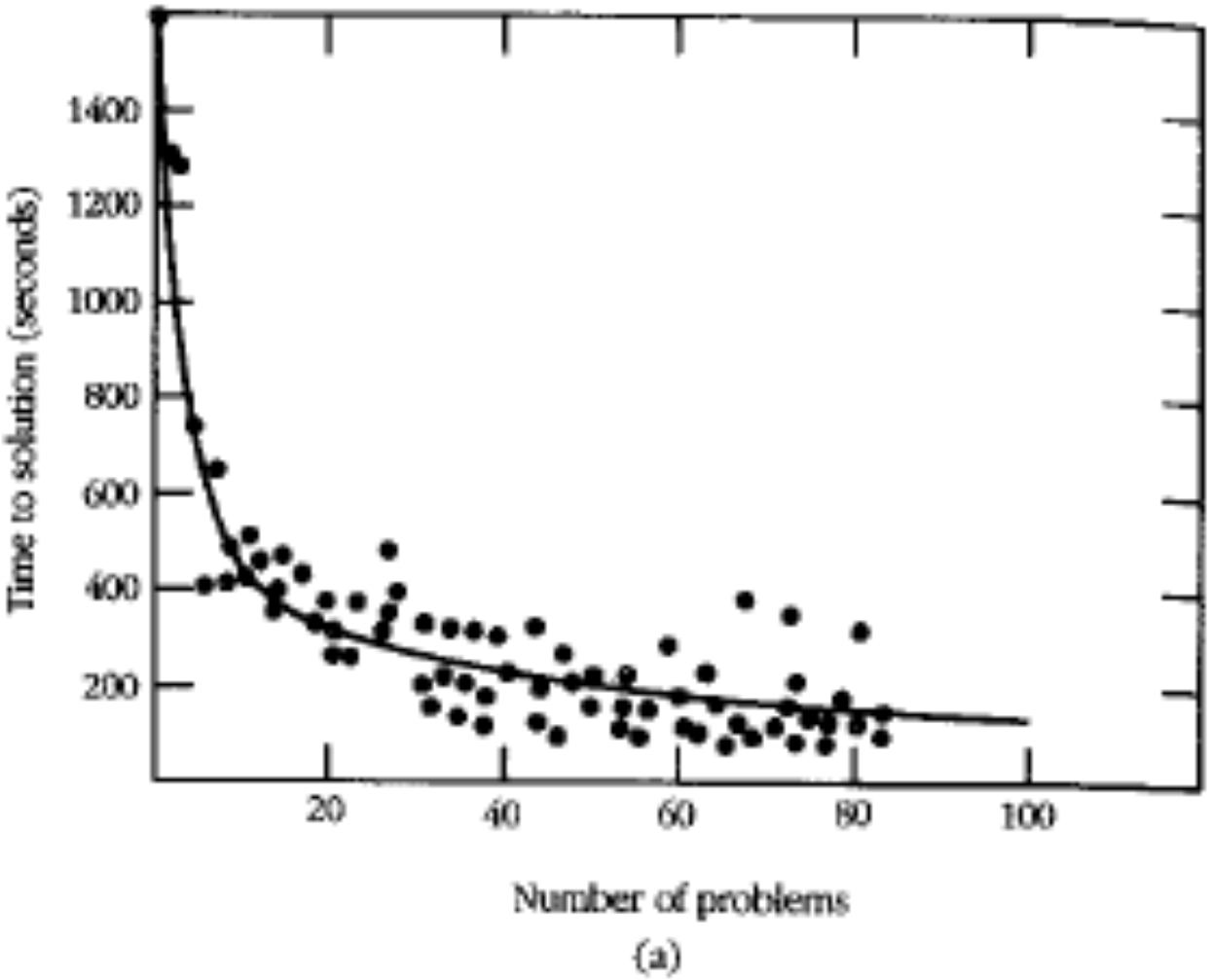
Power Law of Learning proven to apply across many domains

- Simple domains
  - Pressing correct button on stimulus
- Complex problem-solving domains
  - Math
  - Programming
- Real-world domains
  - Cigar-making in factories (Crossman, 1959)

Real-world data

- Are rarely perfectly smooth…
- (At least not without hundreds of students or more)

Example from a minute ago

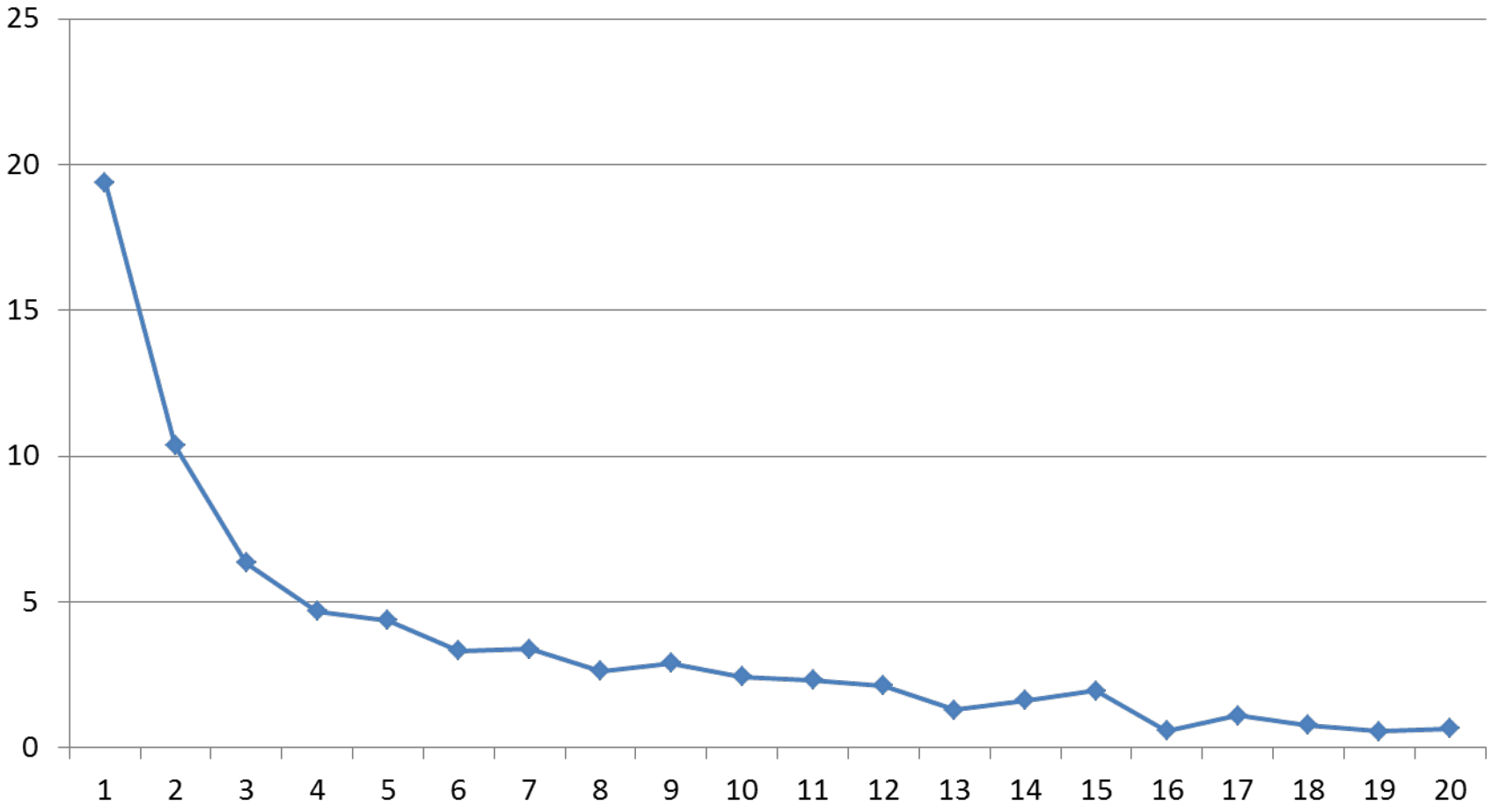


Making inference from learning curves

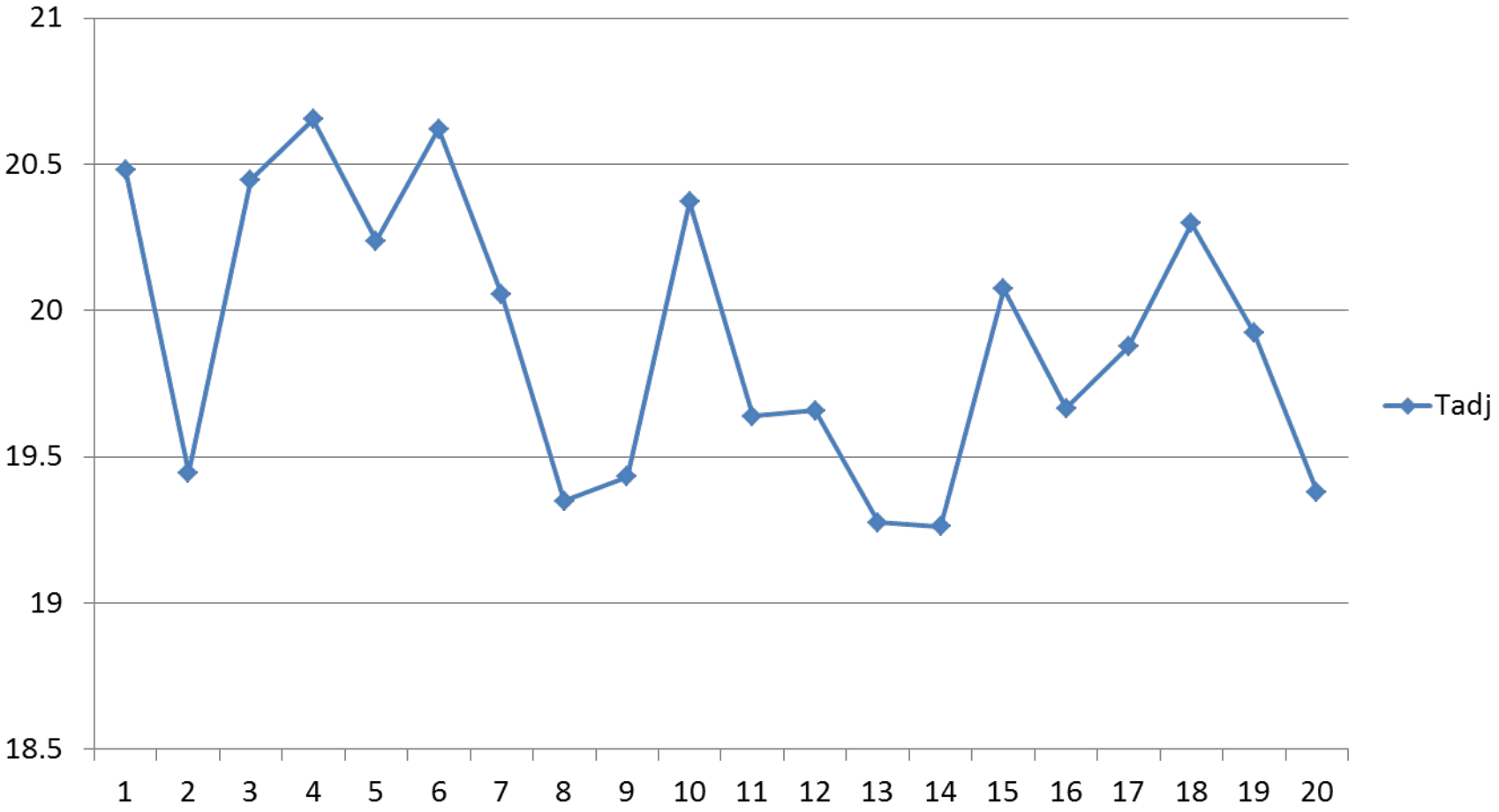
Making inference from learning curves

- Via visual inspection of the curve form

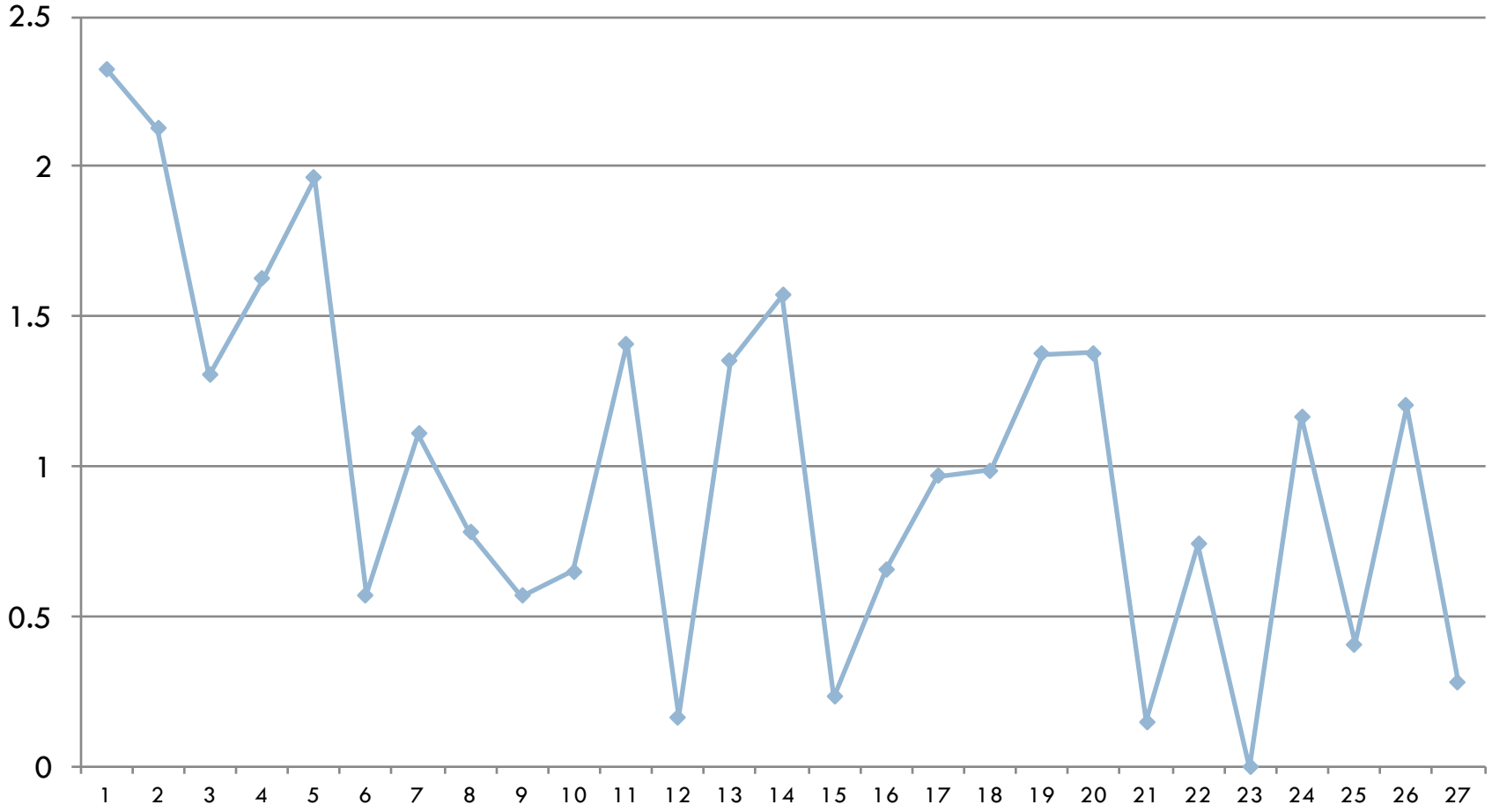
“Normal learning”



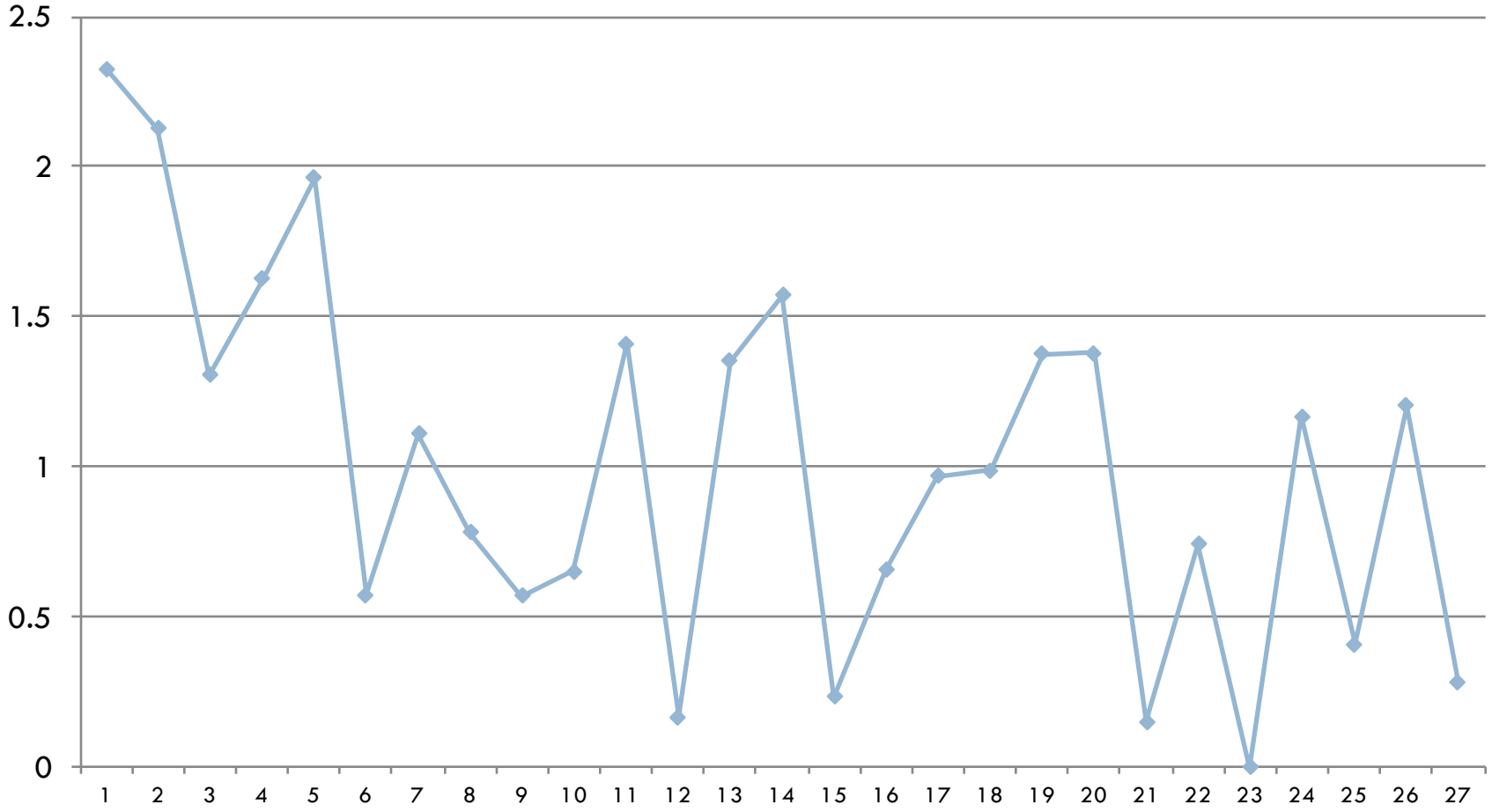
No learning going on



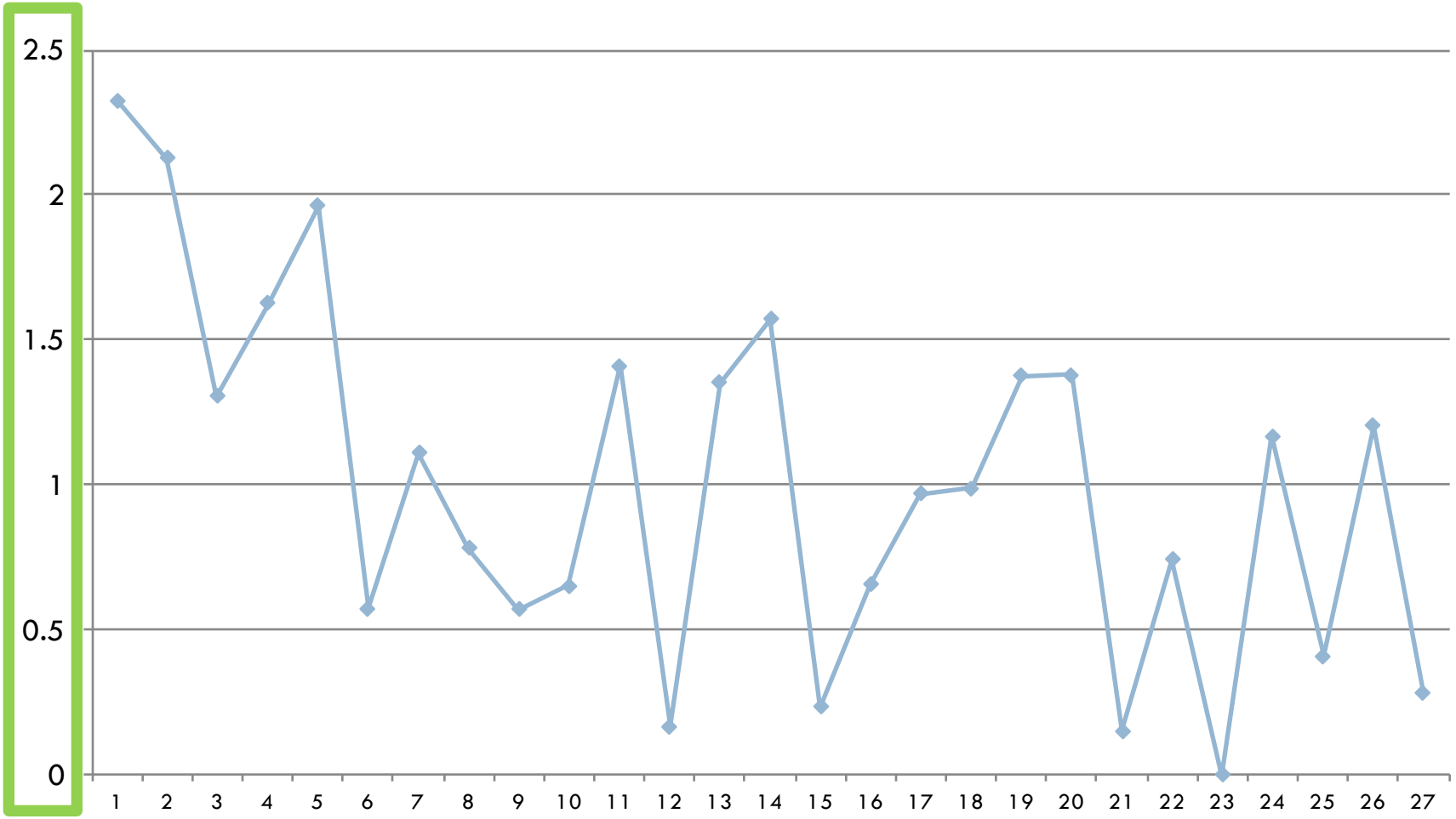
What might this graph mean?



Insert Pause-Continue Quiz Here



Student has already learned skill for the most part



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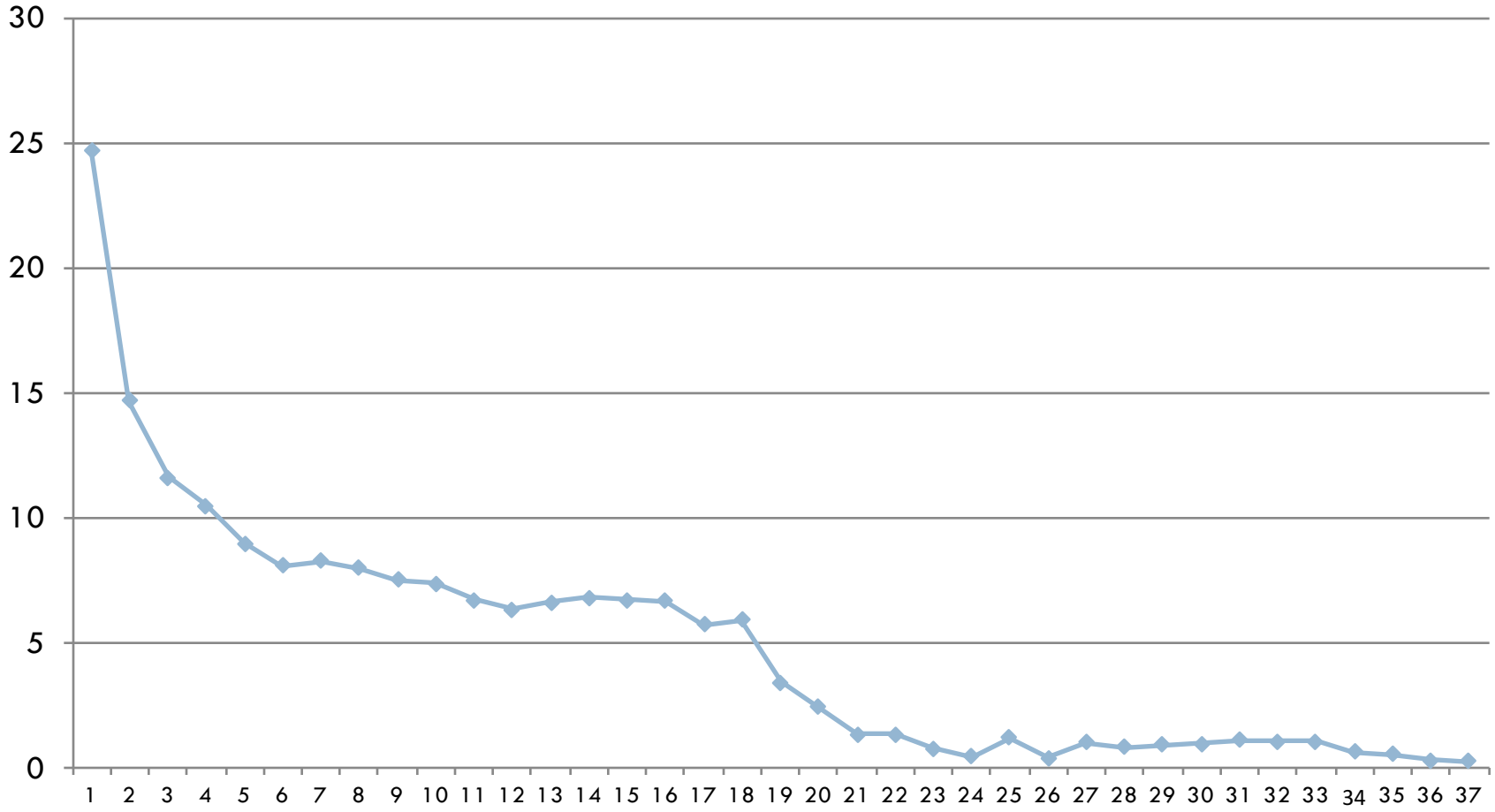

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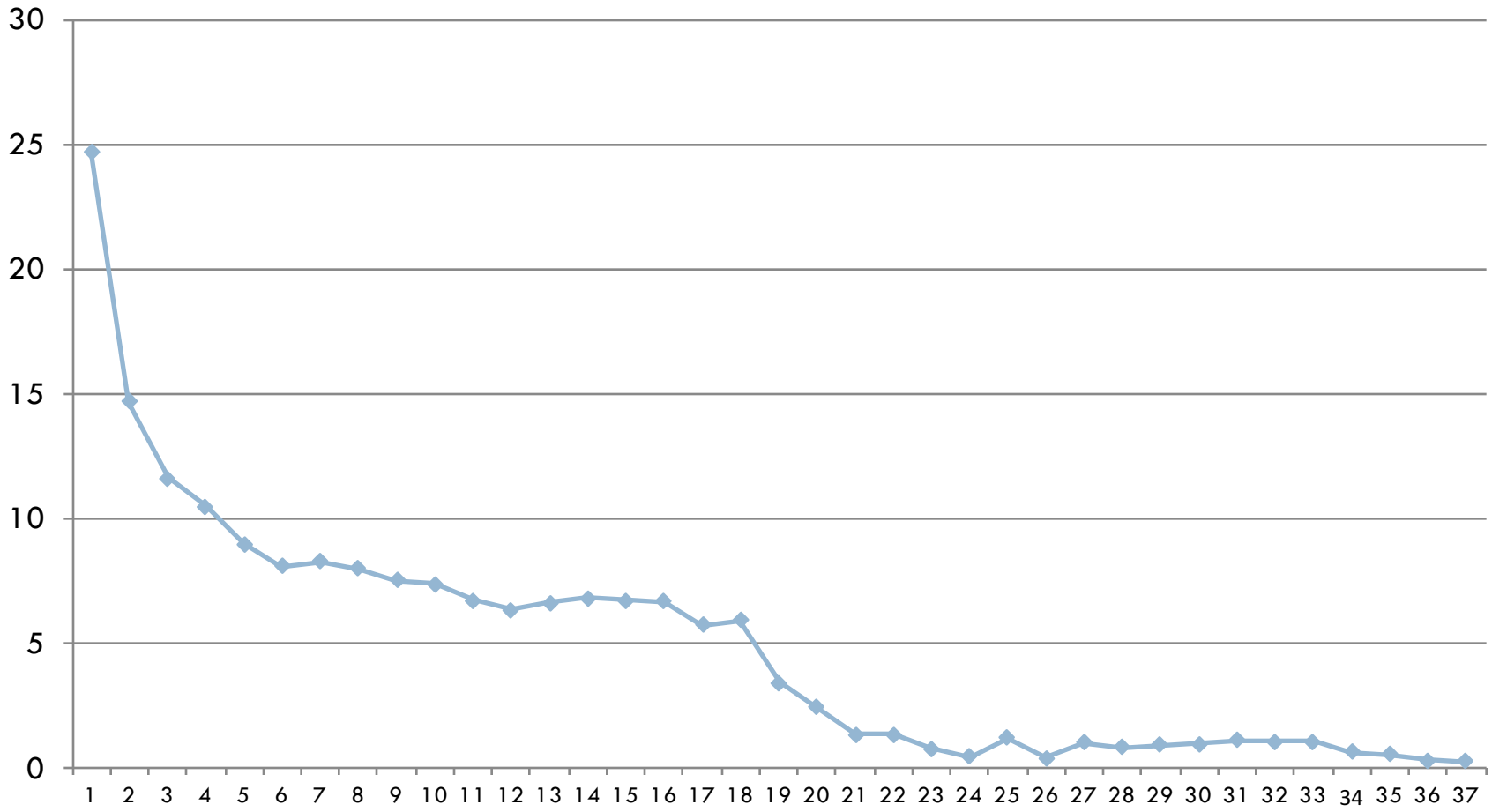
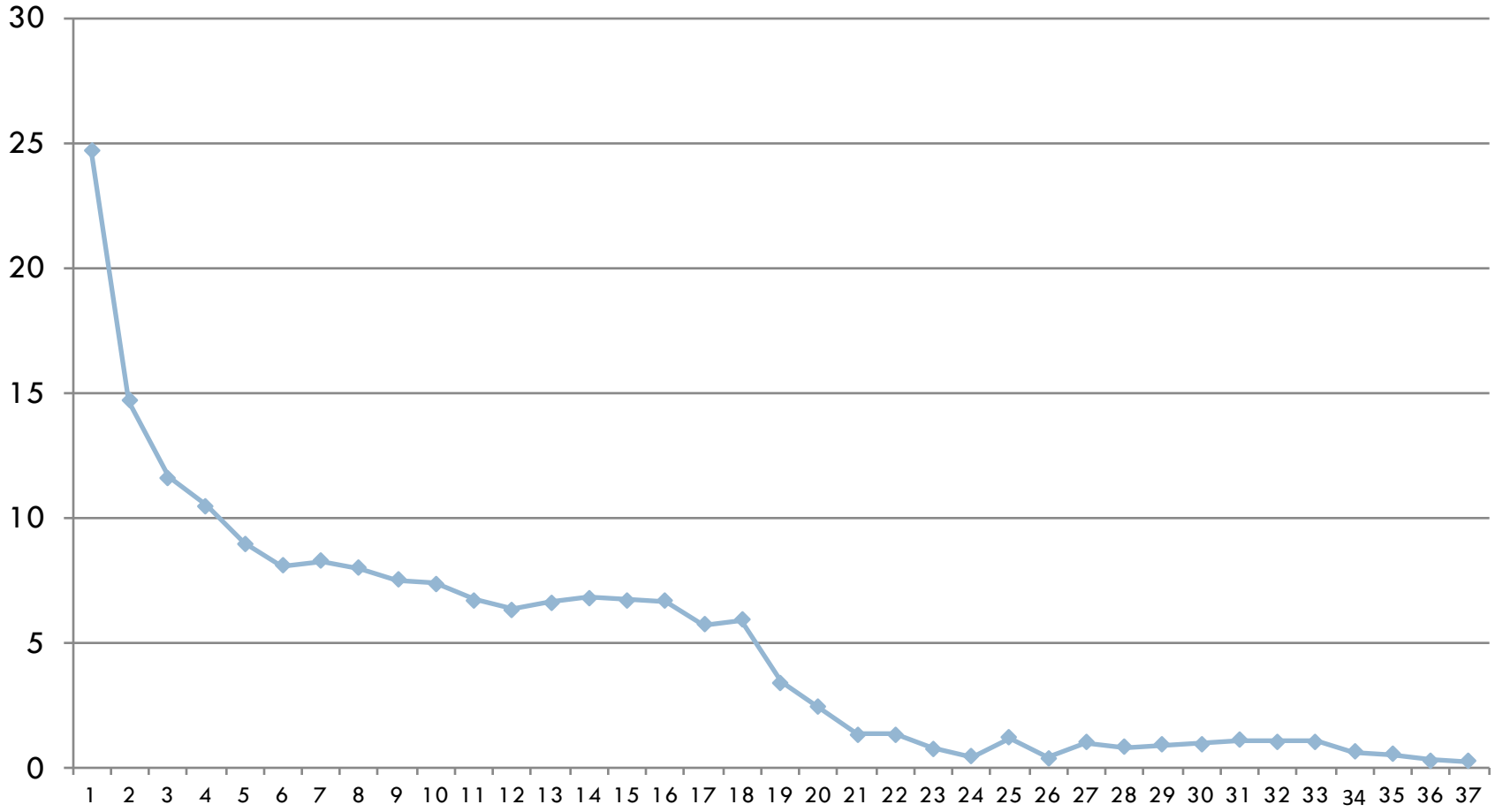


Student learned a new strategy and "broke through" the asymptote



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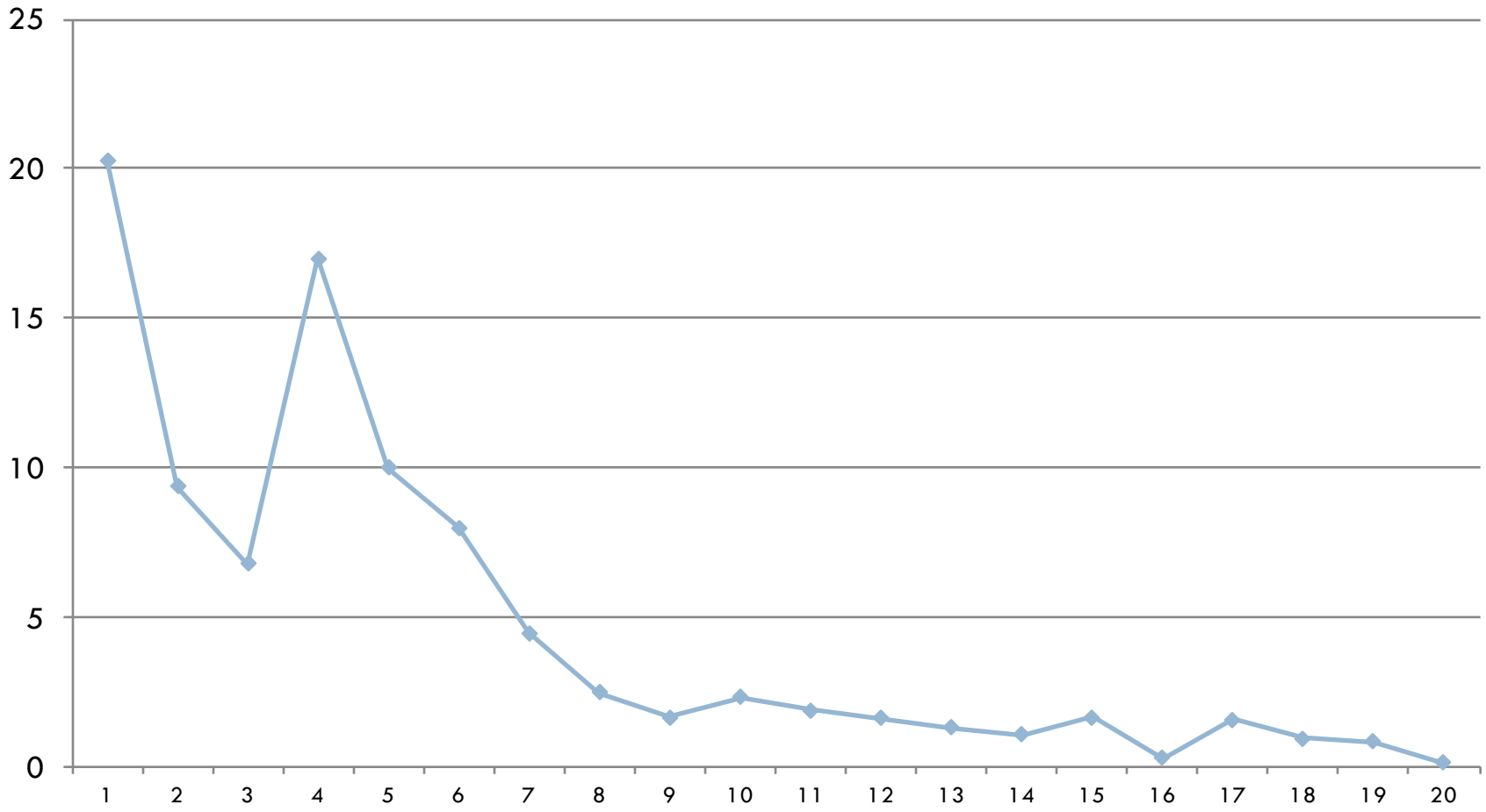

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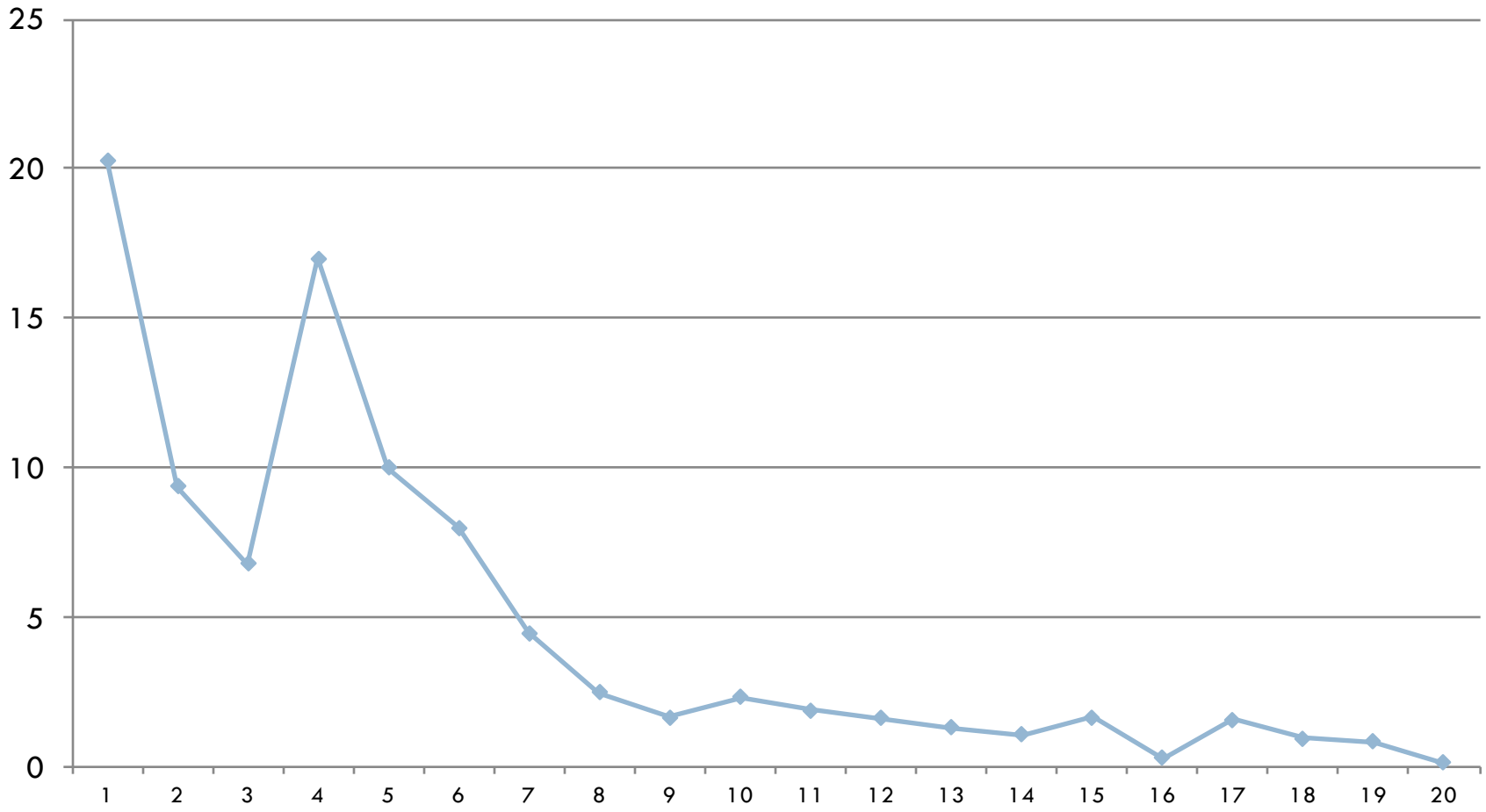
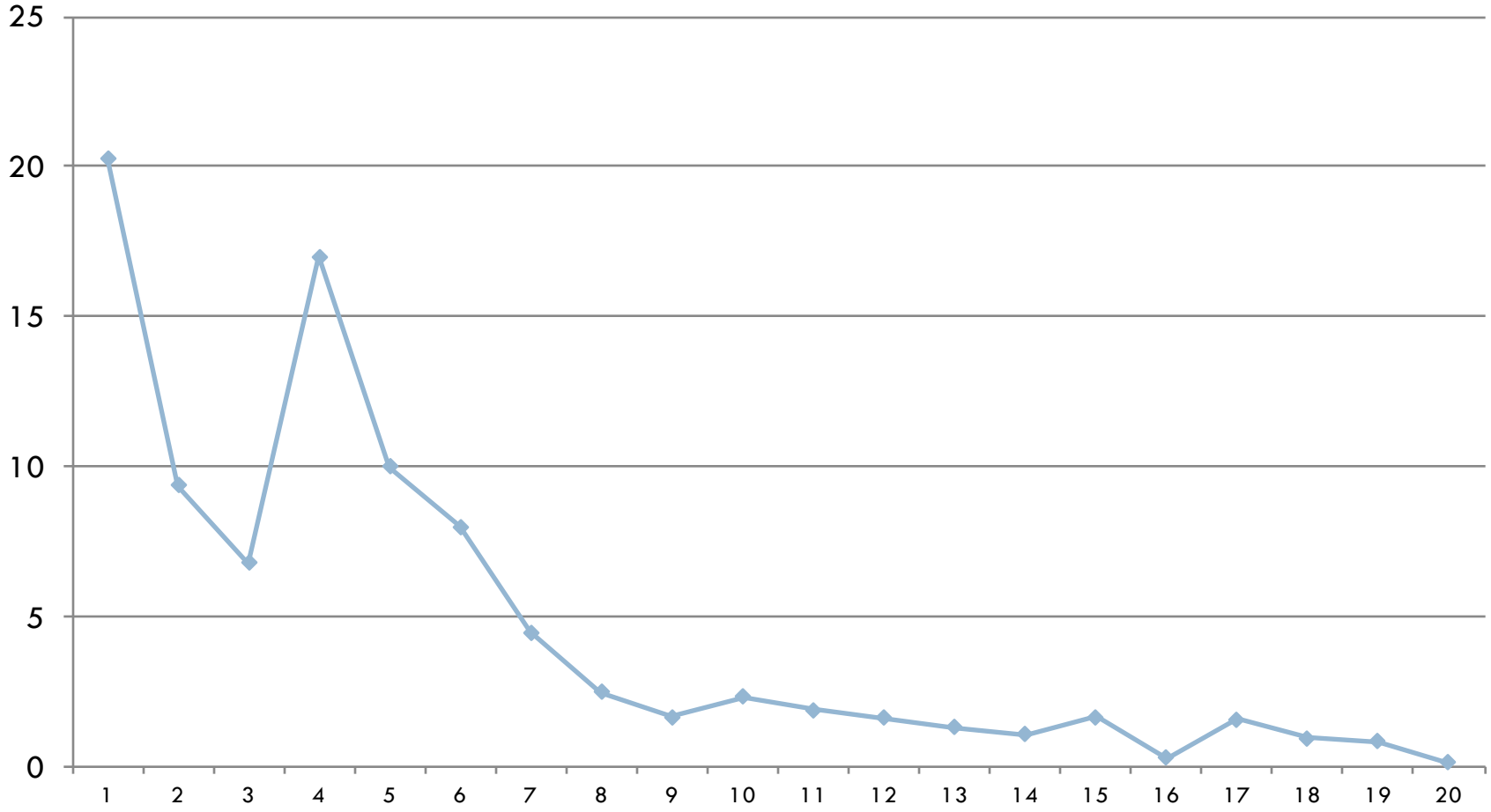


Two skills treated as the same skill (Corbett & Anderson, 1995)



Uses

- To understand how (and whether) a skill is being learned across students

Uses

- To study and refine item-skill mappings in educational software

- As discussed in week 4, Pittsburgh Science of Learning Center DataShop (Koedinger et al., 2010) is a common tool for doing this

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