

# HOW CAN WE ASSESS UNDERGRADUATE STUDENTS' CREATIVITY IN PROOF AND PROVING?

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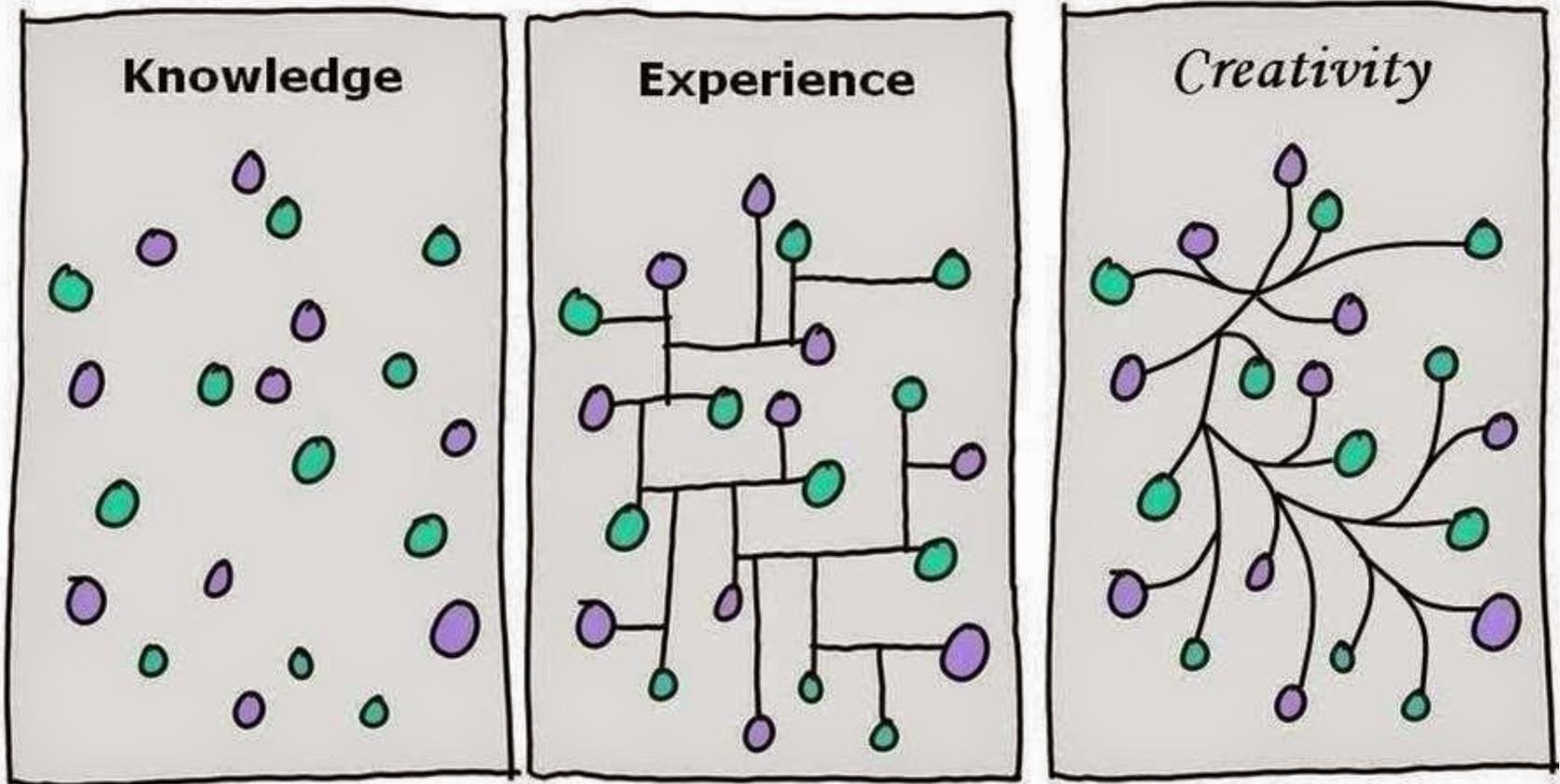
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# What is Creativity?



# Creativity in Proving Rubric (CPR)

Past creativity rubric research:

- AAC&U (Rhodes, 2010): creativity rubric on essay-writing for incoming and outgoing undergraduate students.
- Torrance (1966, 1988): testing for mathematical creativity.
- Leikin (2009): “creativity in problem solving” rubric, influenced somewhat by Silver (1997).
- Savic, et al. (in preparation, 2014): interviews with mathematicians.

# Three Categories of CPR

## **Making Connections**

Ability to demonstrate links between multiple representations, and/or ideas from the current and/or previous course(s) that the student is in.

## **Taking Risks**

Ability to approach a proof and demonstrate flexibility in using different or multiple approaches

## **Creating Ideas**

Ability to state an original mathematical idea that is either pertinent to the proof or can be proven itself

# Using CPR

- Theorem: If 3 divides the sum of the digits of a number, then 3 divides that number.
- Please attempt to prove
- Grade this proof based on however you grade proof in your courses (out of 10)
- CPR draft!

# Discussion

- Which levels do you think Student 10's proving process belongs to in each of the 3 categories? Why?
- What is the difference between your grading and your rubric score?
- What insight did you gain from watching the student's proving process?

# Background

- Sriraman (2005) K-12 Creativity vs. “Mathematics” Creativity
- Zazkis and Holton (2009) discussed creativity in undergraduate mathematics, posing problems in many different content areas

# Research Questions

- If mathematical creativity is both enacted and valued by mathematicians (Sriraman, 2009), then **how can mathematical creativity be enacted and valued by our undergraduate students in proof-based courses?**
  - What are some critical aspects of teaching environments that enhance creativity?
  - As a formative assessment tool, would the use of CPR help motivate students to be “more” creative?

# Methodology

- Interviews conducted with seven mathematicians (2013-2014)
- Video of a full semester introduction to proof course (Spring, Fall 2014)
- Data collected from students doing homework and tests using LiveScribe pens
- Conducted interviews with 8 students
- Teaching with rubric in Fall 2014

# In-Class Use of CPR

- Setting up the environment in the classroom:
  - Discuss/demonstrate proving attempts
    - Emphasize that mistakes can help
  - Pose theorems that have multiple solutions
  - Assign conjecturing tasks for homework
- Use the CPR when students are demonstrating or presenting proofs/reasoning in the classroom

# Motivation

“in seeking to facilitate the development of talented young mathematicians, **neglecting** to recognize **creativity may drive** the creatively **talented underground or**, worse yet, cause them to **give up** the study of **mathematics** altogether” (Mann, 2005, p. 239).

# References

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# Discussion/Questions?

- How do you see CPR being used in class?
- How can we improve CPR?
- What other aspects of creativity do we need to pay attention in classroom and on our rubric?
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**THANK YOU!**