University of Lethbridge

6 litres of water …

You need to draw exactly six (6) litres of water from the river; but, the only two containers you have hold four (5) litres and nine (9) litres respectively. How do you obtain 6 litres of water?

University of Lethbridge

Teaching and Learning Problem-Solving Skills

2012 Symposium on Scholarship of Teaching and Learning

Teaching and Learning Problem-Solving Skills

Dr. Shelly Wismath
University of Lethbridge

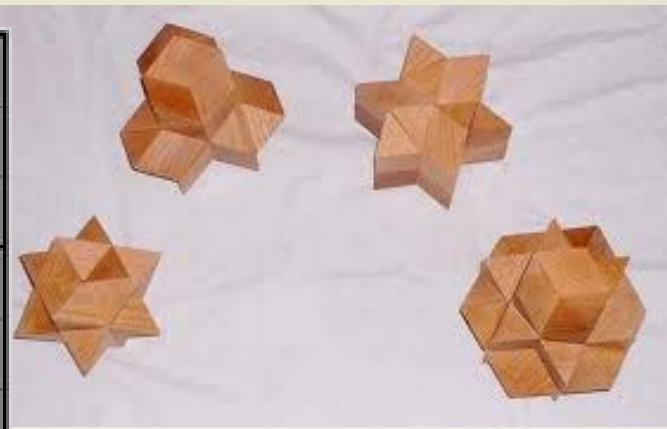
Ms.Maggie Zhong
University of Lethbridge

Mr. Doug Orr
University of Lethbridge

A New Course …

Liberal Education 2850:
Puzzles and Problem Solving

		8		3		5	4	
3			4		7	9		
4	1				8			2
	4	3	5		2		6	
5								8
	6		3		9	4	1	
1			8				2	7
		5	6		3			4
	2	9		7		8		



Four Questions:

1. What are problem-solving skills?
2. How can they be learned?
3. How can they best be taught?
4. How can they be measured?

The Students

Spring 2010 – 35 students

Spring 2012 – 60 students

Diverse reasons for enrolment, majors, faculties, learning-styles, thinking-styles, personal motivations, goals, …

Gender:

53% Female // 47% Male

The Class …

Primarily non-traditional (i.e. non-lecture), hands-on, constructivist, authentic learning:

- Present a problem (like the two-pail puzzle)
- Students work individually or collaboratively
- Instructors & TAs circulate to discuss, prompt, question, encourage, …

“Flipping” the Class

Creating a “community of learners” …

•Whole class “debrief” to share challenges, interpretations, strategies, and solutions

•***Teachers as Learners***

Students as Teachers

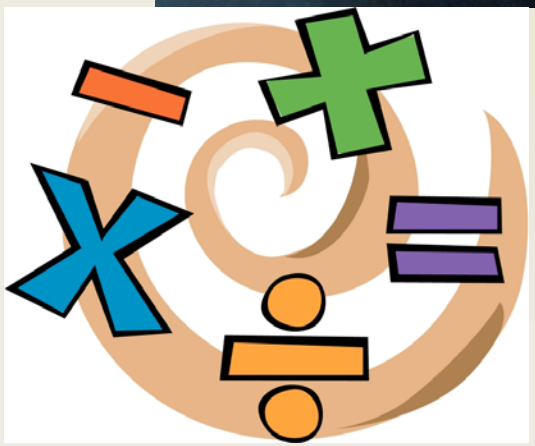
•Students bringing their own puzzles and problems to share

•Shared learning

One Solution …

Action	5 L Pail	9 L Pail	Total
Fill 5 L pail	5	0	0
Pour 5 L pail into 9 L pail	0	5	5
Fill 5 L pail	5	5	10
Fill 9 L from 5 L pail	1	9	10
Empty 9 L pail	1	0	1
Pour 5 L pail into 9 L pail	0	1	1
Fill 5 L pail	5	1	6

A Personal Pedagogical Shift



1. What are problem-solving skills?
2. How can they be learned?
3. How can they best be taught?
4. How can they be measured?

Research

Two research projects:

•Supported by the U of L
"Teaching Development Fund"

- 2010 (Pt 1)
  - 27 participants
- 2012 (Pt 2)
  - 38 participants

The Research Project(s)

Part 1 – 2010:

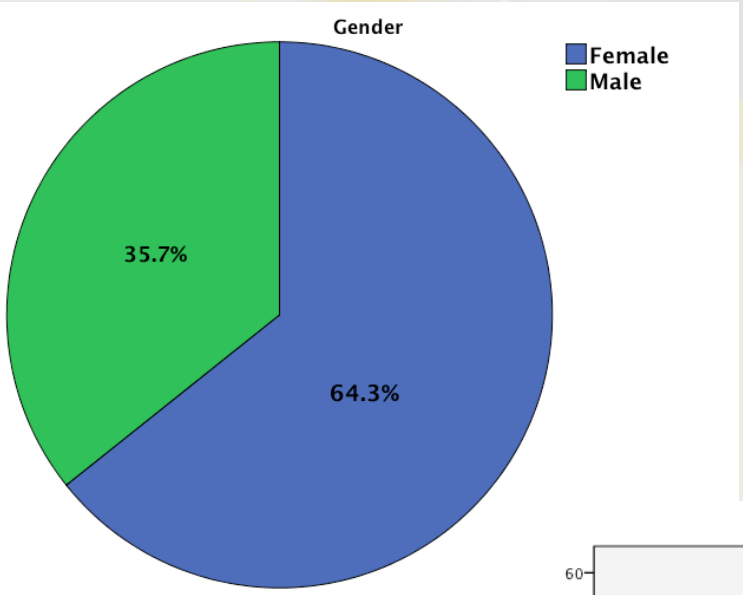
- Student demographics
- Student attributes
  - Thinking-Styles (Gregorc, 1979)
  - Learning-Styles (Barsch, 1991)
  - Self-Perceptions Survey
- Student reflections
  - Three written assignments

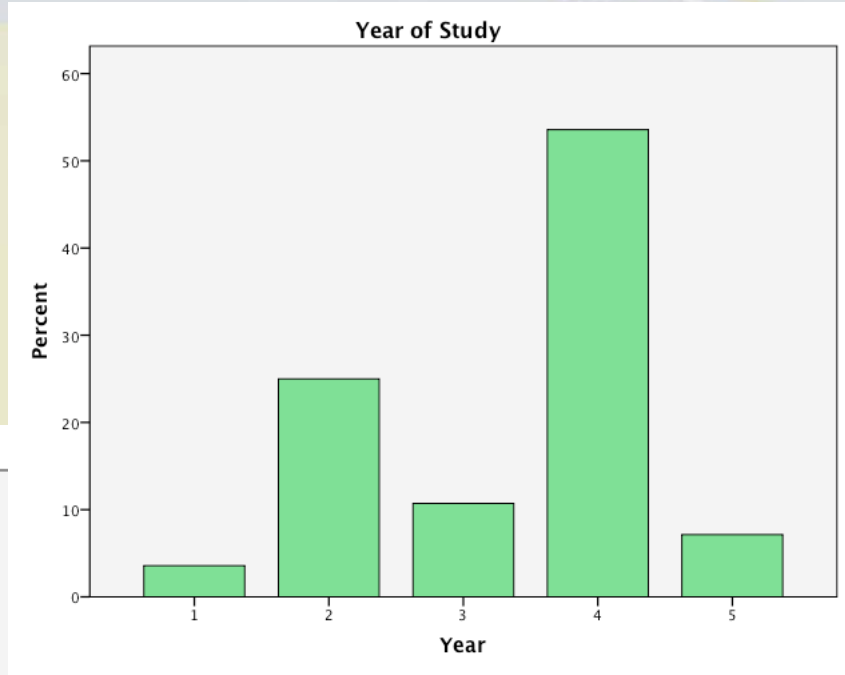
Student Survey

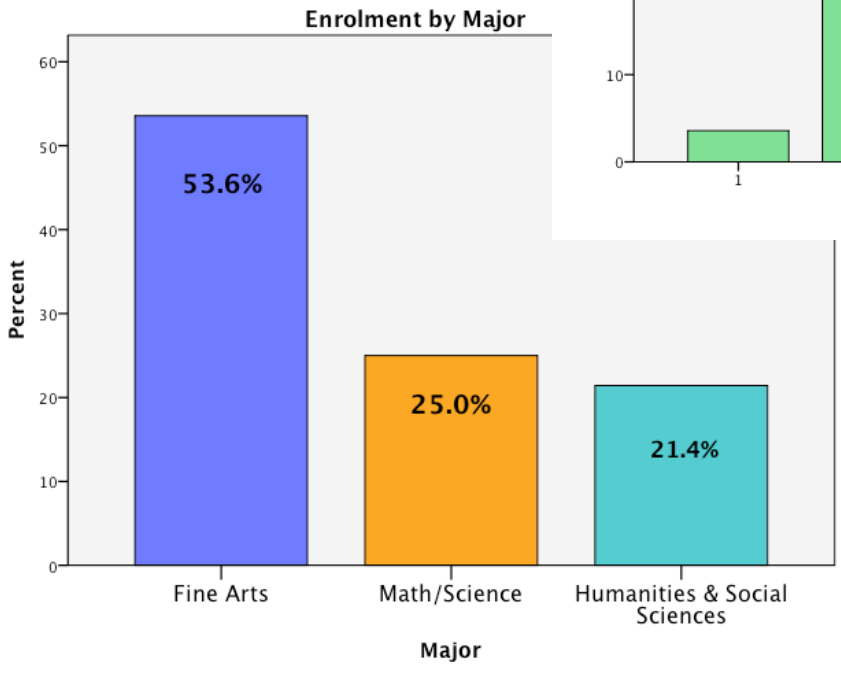
Self-reported

- affinity for problems, puzzles, games, reading, mathematics, …
- creativity, persistence, focus, patience, determination, consistence, …
- analytical skill, linearity, ability to abstract, …
- collaboration, cooperation, ability to brainstorm, …

Who participated in 2010?

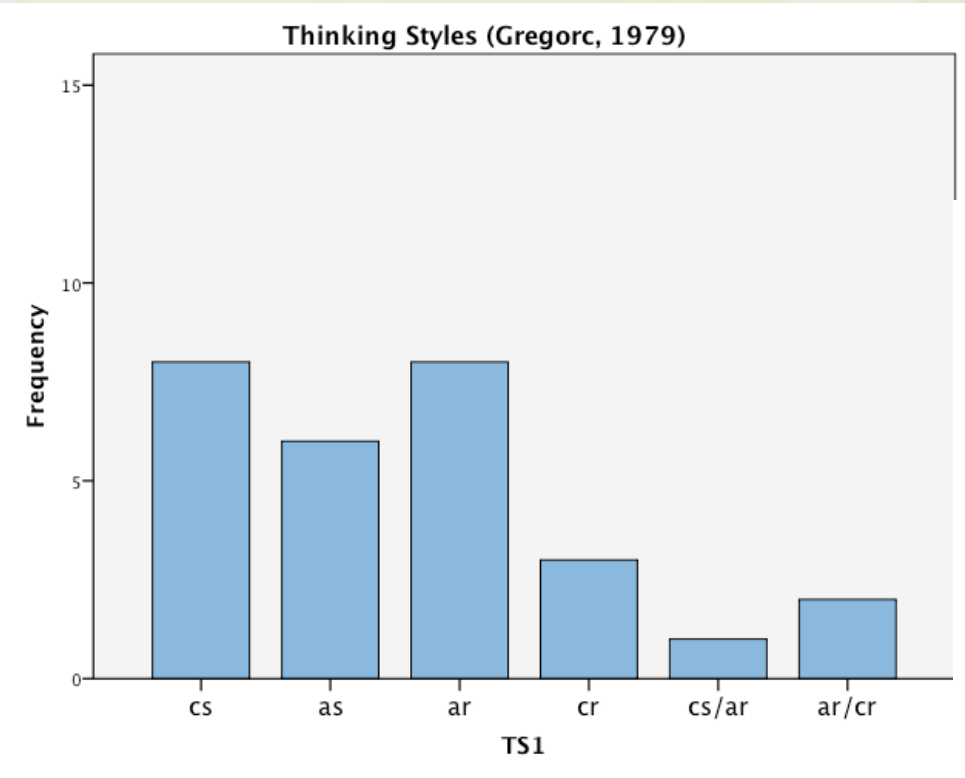


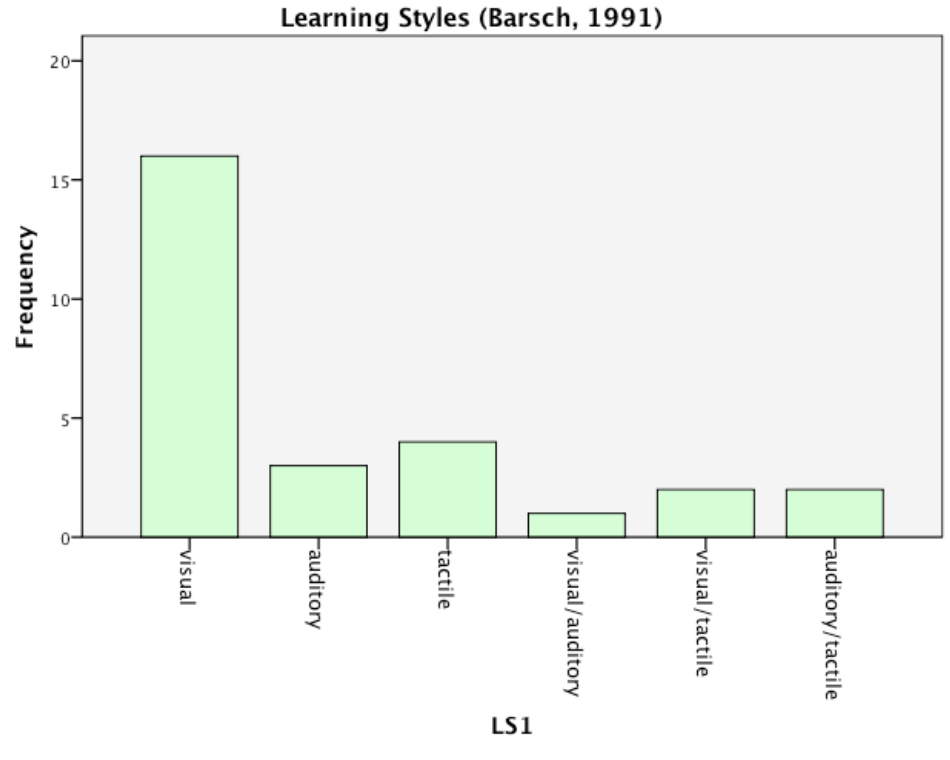




Thinking & Learning Styles

2010





What changed significantly?

2010

Not surprisingly – not much:

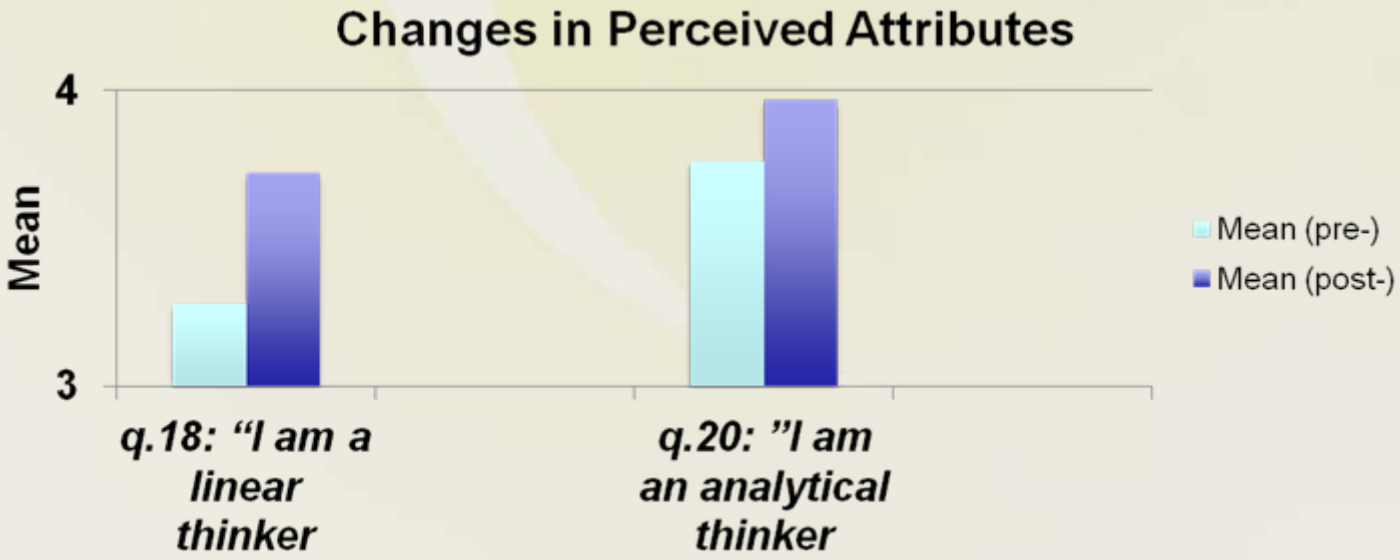
- not reported thinking styles
- not reported learning styles
- few perceived attributes

But …

What changed significantly?

2010

Question	Mean (pre-)	Mean (post-)	*p*-value
q.18: "I am a linear thinker"	3.28	3.72	0.005
q.20: "I am an analytical thinker"	3.76	3.97	0.031



Lessons from part 1

2010

1. Attribute data provides important context
2. Vital answers reside qualitatively in the student reflections
3. Attributes provide students with information to understand and construct their own learning
4. Metacognition may be a (the?) vital facet of problem-solving

Part 2 - 2012

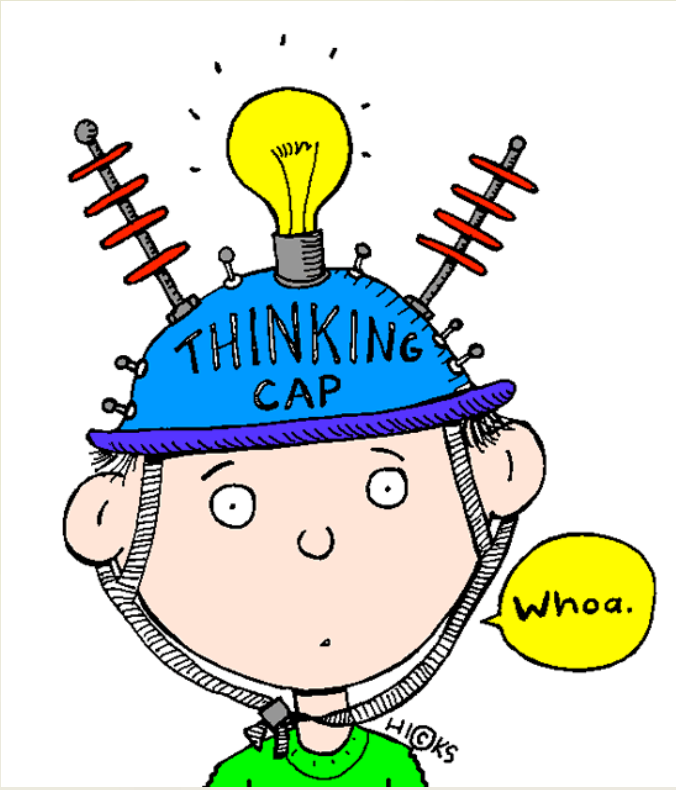
1. What are problem-solving skills?
2. How can they be learned?
3. How can they best be taught?
4. How can they be measured?

Do the students know?

Metacognition

A focus for part 2: 2012

- Teach about metacognition
- Teach and practice metacognitive skills
- Apply metacognition to problem-solving
- Reflect on metacognitive practice



The Research Project(s)

Part 2 – 2012:

- Student demographics and attributes
  - Thinking-Styles (Gregorc, 1979)
  - Learning-Styles (Barsch, 1991)
- **Revised:** Self-Perceptions Survey
- **Revised:** Student Reflection Assignments
  - metacognition and metacognitive skills
- **Added:** Focus-Group discussion session

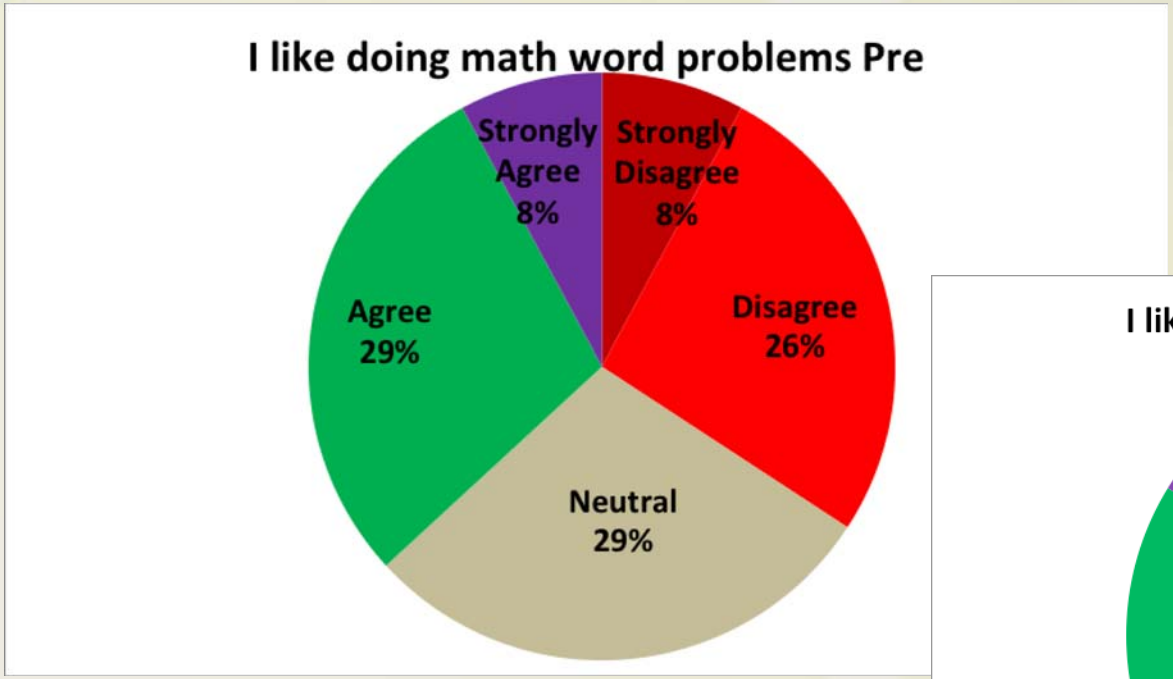
Results - 2012

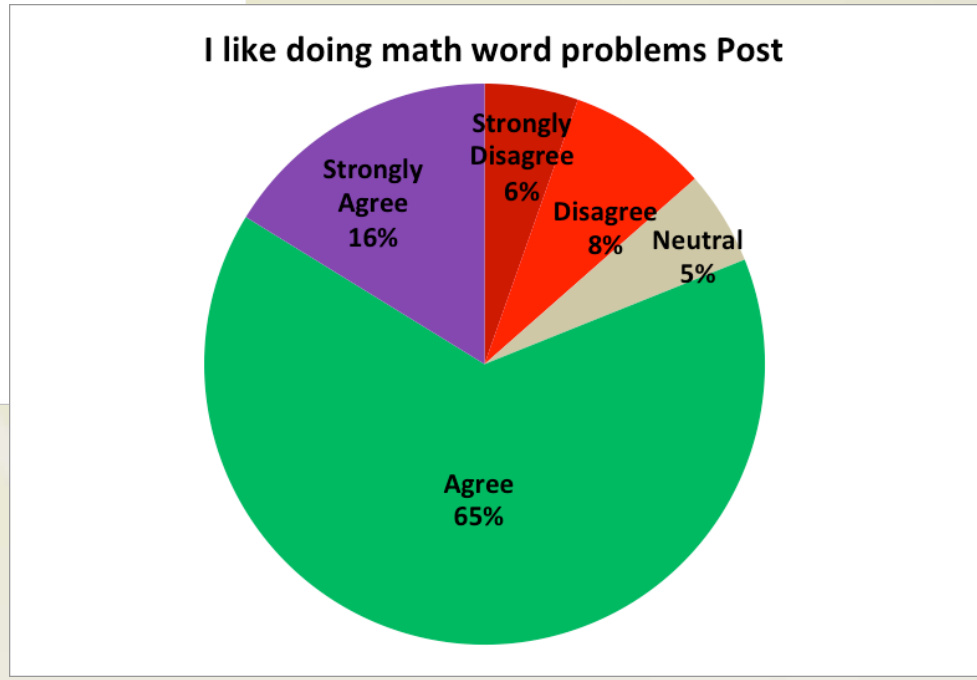
Four key self-perception questions:

- *"I like doing math work problems"*
- *"I like to find the one right answer to a question"*
- *"I have good problem-solving skills"*
- *"I am confident about my ability to solve problems"*

What changed?

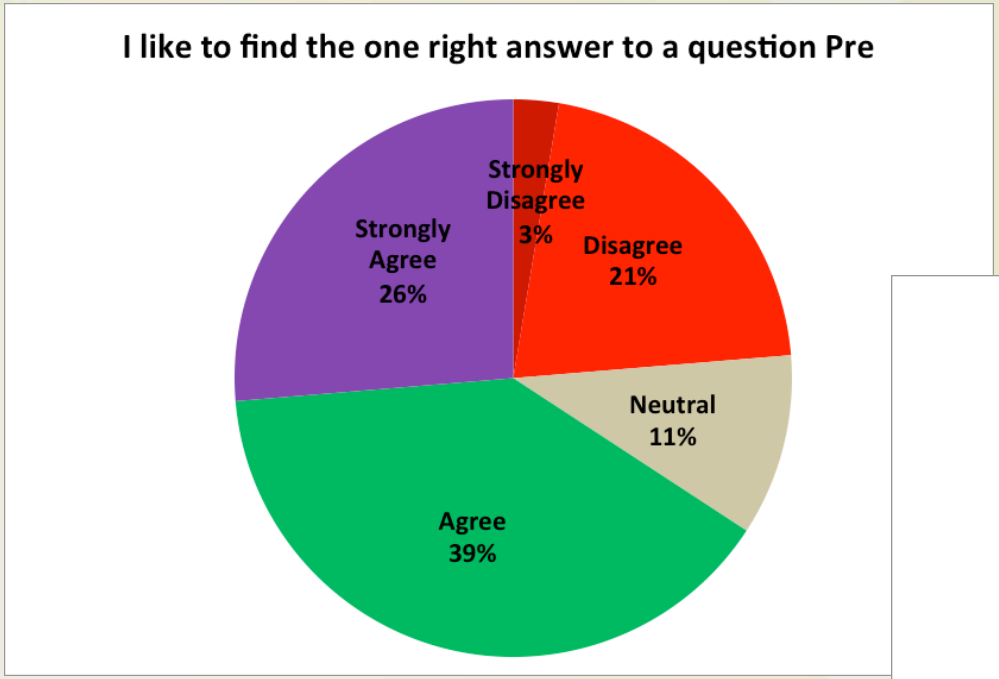
2012

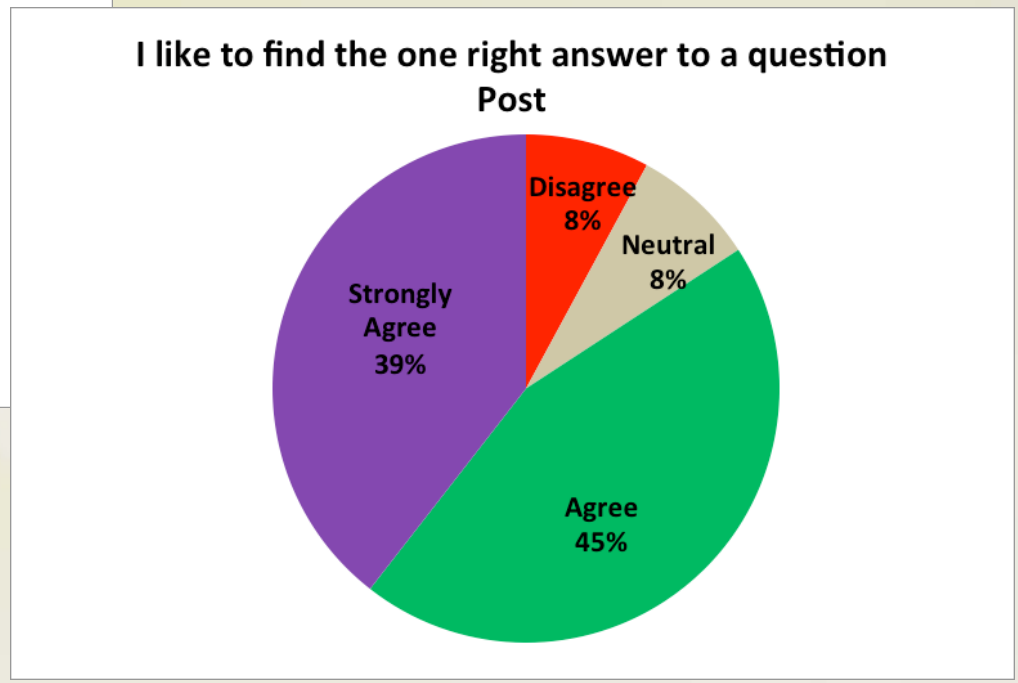




What changed?

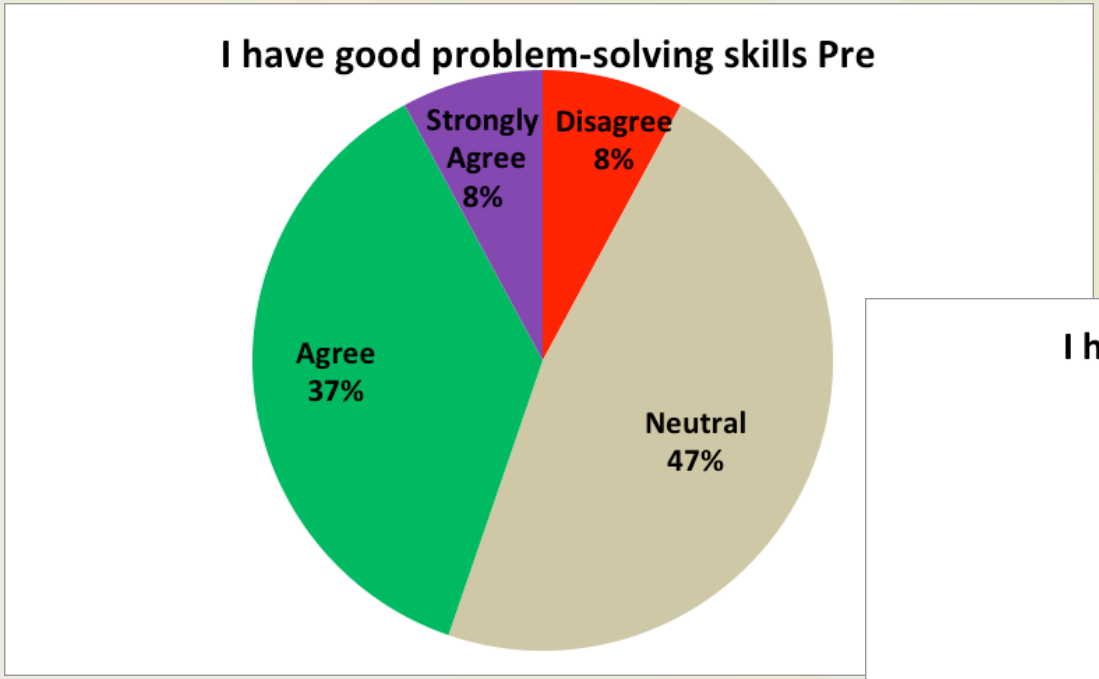
2012

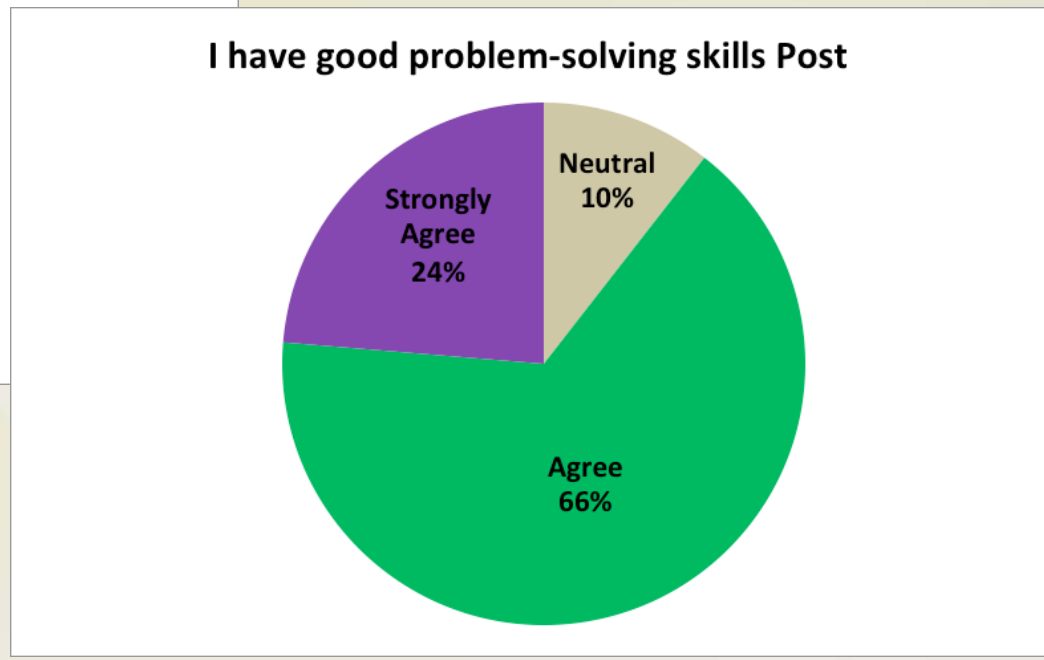




What changed?

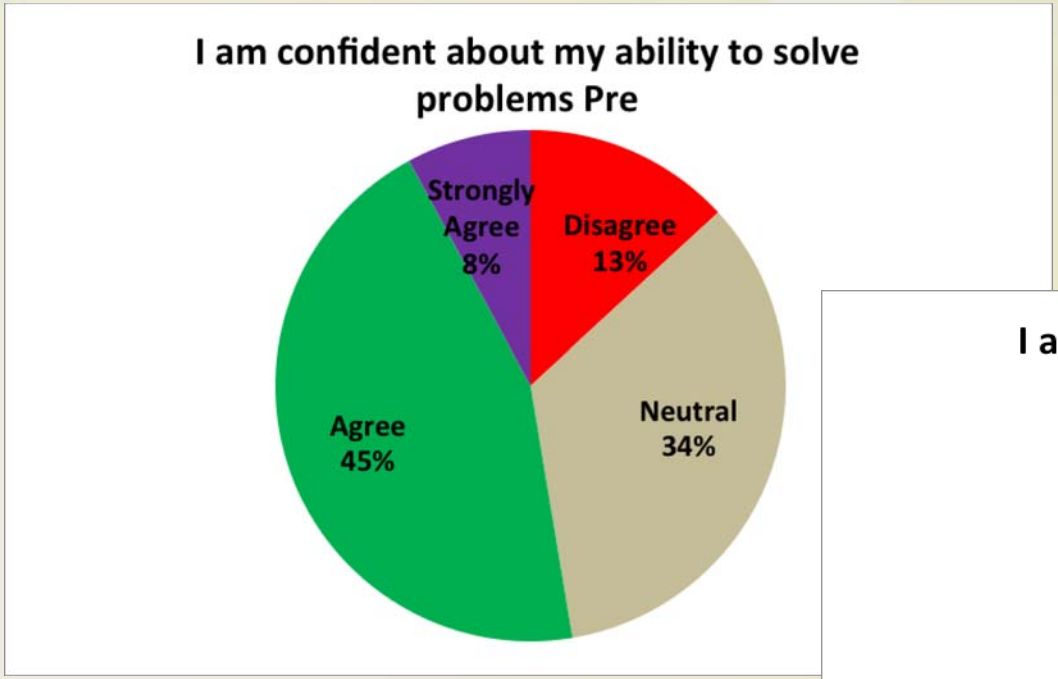
2012

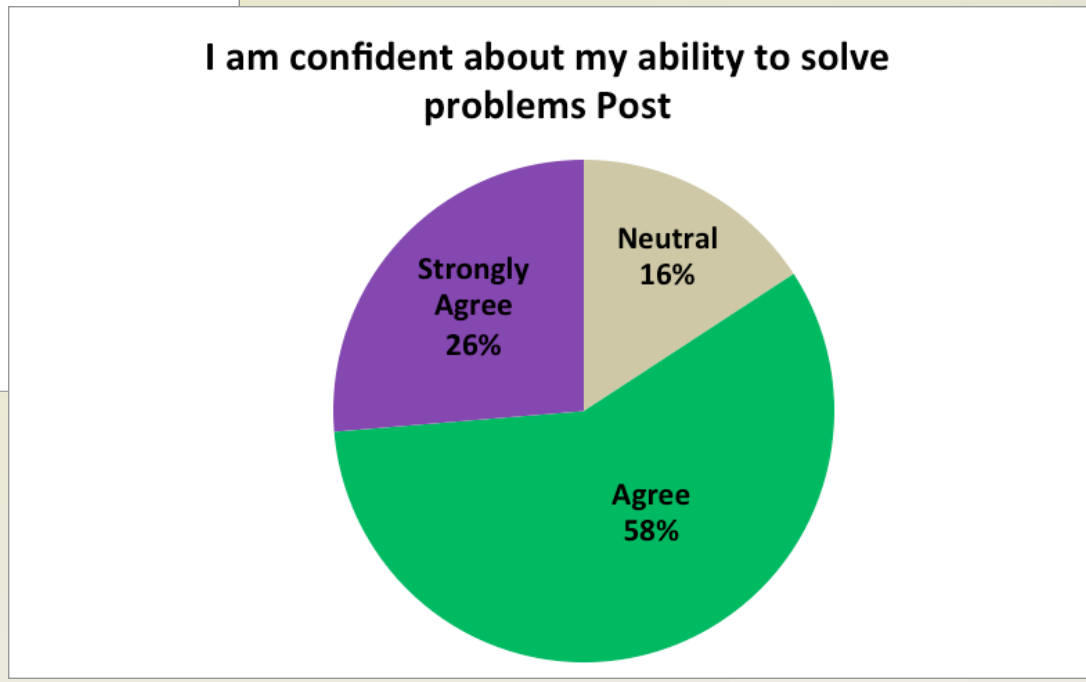




What changed?

2012

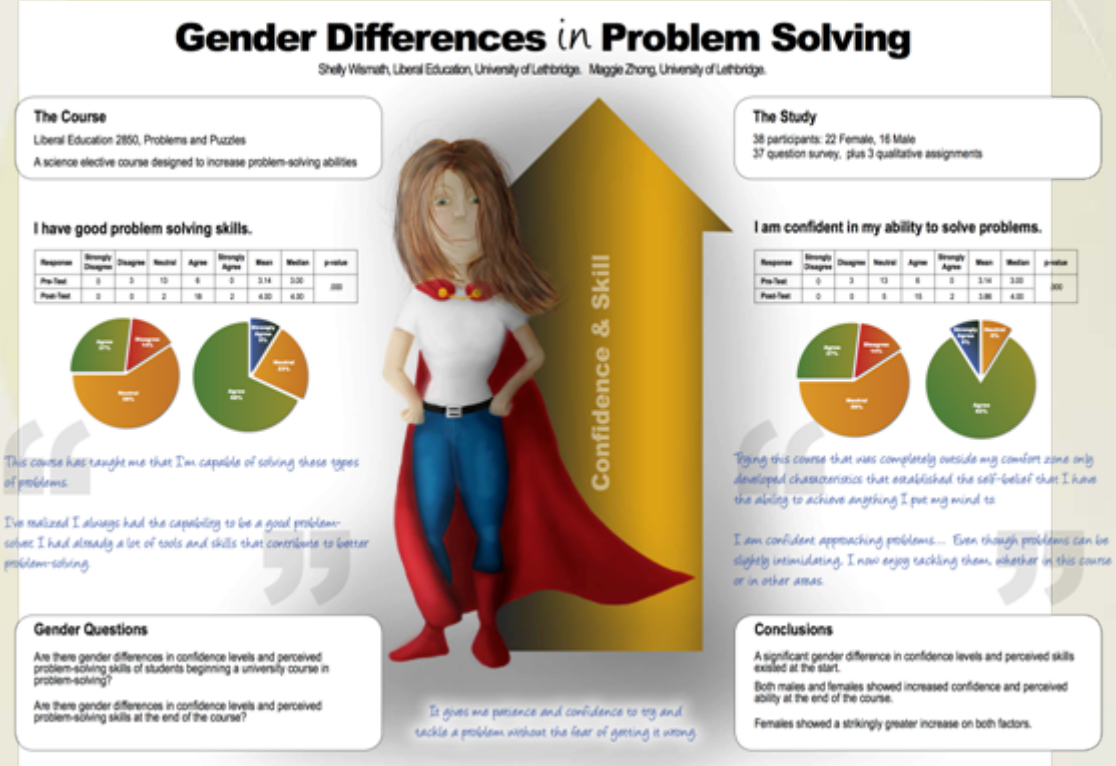




… and some significant gender differences

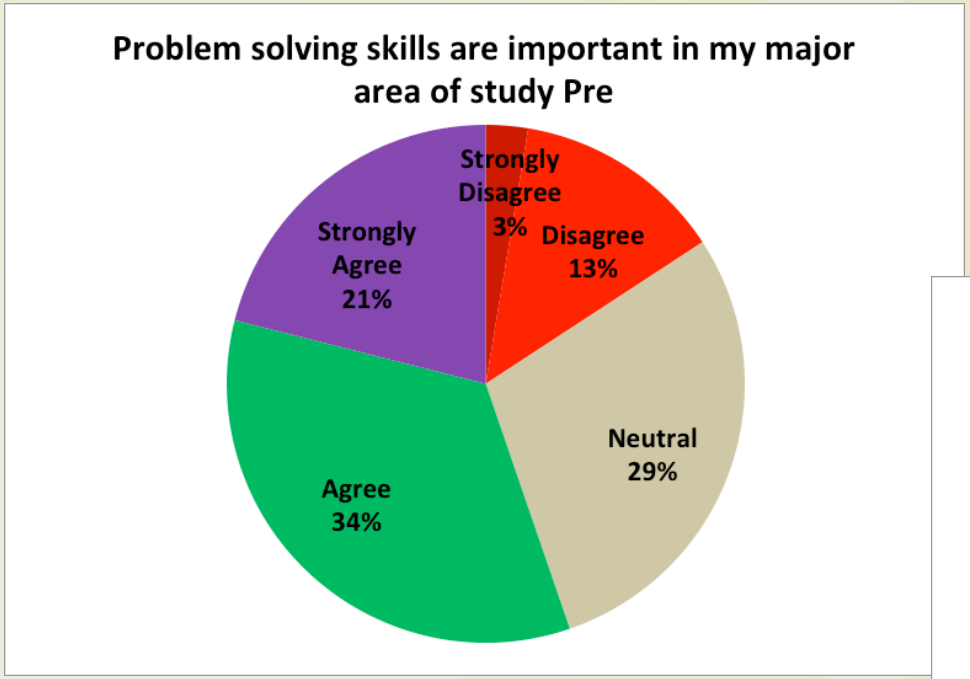
Two questions:

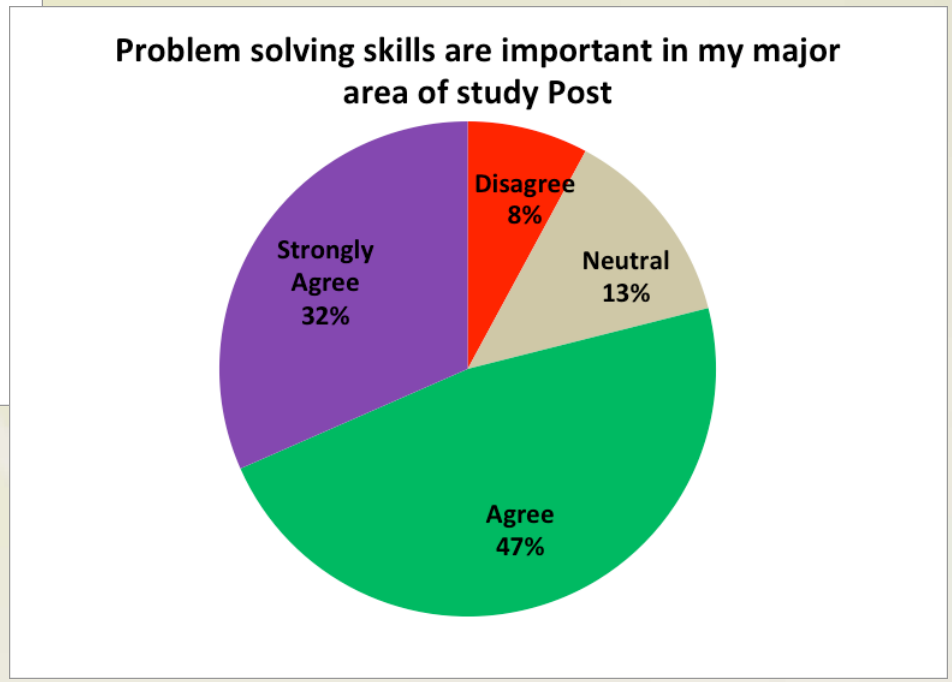
- *"I have good problem-solving skills"*
- *"I am confident about my ability to solve problems"*



Another important question

2012





What about metacognition?

Student Reflections:

Confidence

Student Reflections:

Self-Awareness

Student Reflections:

Transfer

Student Reflections:

Explanation

Student Reflections:

Collaboration

Student Reflections:

Life-long learning

Student Reflections:

Course value

Student Reflections:

Student Reflections:

Student Reflections:

Conclusions

Conclusions

New Directions

New Directions

Teaching and Learning Problem-Solving Skills

Questions

Comments

Discussion?

Teaching and Learning Problem-Solving Skills

Thank You

Contact:

Dr. Shelly Wismath

University of Lethbridge

wismaths@uleth.ca