

# Correlating Knowledge of Landscape Formation Timescales and Geologic Time.

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# Outline

1. Context
2. Geotime concepts
3. Landscape Identification and Formation Test (LIFT)
- 4. Results & implications**
5. Lessons learned, and questions

# Context

1. Science Education Initiative in Earth & Ocean Science, striving for ....
  1. Evidence based instructing (visible thinking)
  2. Clarity of what students will be able to DO (and why)
2. Active learners = student centric perspective:
  1. Reduce (not eliminate) “*teaching = telling*”
  2. Increase:
    1. Visibility of thinking
    2. Opportunities for feedback to students AND instructors

# Geotime concept test development

- **Experts:** Interviewed to identify topics of interest.
  - 20 questions produced.
- **Students:** Validation via iterative think-aloud interviews.
- **The Test:** Range of concepts & Bloom's level coverage.

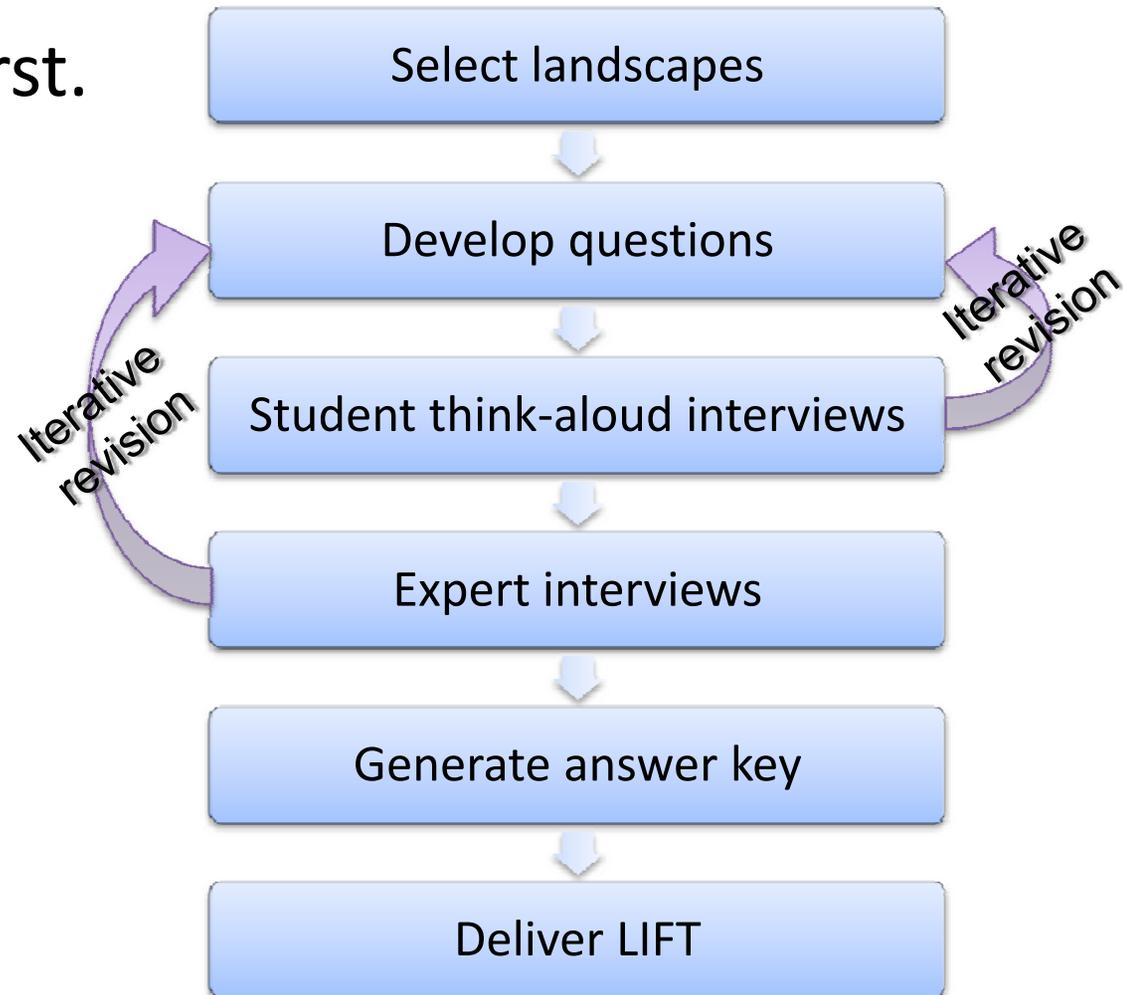
	# Qns	
<b>Key Concepts</b>	<b>GeoT</b>	
Timescale	3	→ 3
Relative dating	6	→ 4
Absolute dating	4	→ 1
Earth history	6	
Uniformitarianism	1	
Processes & rates	0	

<b>Bloom's level</b>	<b>GeoT</b>
knowledge	8
comprehension	3
application	5
analysis	4

After using GeoTime in a 3<sup>rd</sup>/4<sup>th</sup> yr elective course, eight questions were selected for use in L.I.F.T. (landscape identification and formation timescale test)

# Landscapes concept test development

- Questions developed first.
- **Student interviews** crucial for validation.
- **Expert interviews** used to generate ranges of acceptable answers.



# Answer ranges from 7 experts:

12 landscapes:                      seconds < T < 10<sup>8</sup> yrs.

Impact crater	*a								b		c	d	e	
Fault	*a			b		c	d		e					
Landslide	*a			b		c	d		e					
Lava Flow	a		*b			c		d		e				
Mud Cracks	a		*b			c		d	e					
Sand Dune	no correct answer													
Alluvial fan			a			b		c	*d		e			
Hoodoos								*a			b	c	d	
River					a	b		c	*d		e			
U-shaped Valley								a	*b		c	d	e	
Volcano						a		b	*c				e	
Mountains									a	b	c	*d		
	sec.	min.	hrs	days	wks	mths	1's	10's	100's	10 <sup>3</sup> 's	10 <sup>4</sup> 's	10 <sup>5</sup> 's	10 <sup>6</sup> 's	10 <sup>7</sup> 's
								years						

**Boxed** = range from all experts

**Shaded** = expert consensus after removing outliers

\* = deemed "best" i.e. the "correct" answer

**a-e** = answer options on the LIFT.

lowest and highest options included "or less" and "or more".

# LIFT question sequence:

1. Image projected for 45 seconds.  
Students answer the following:



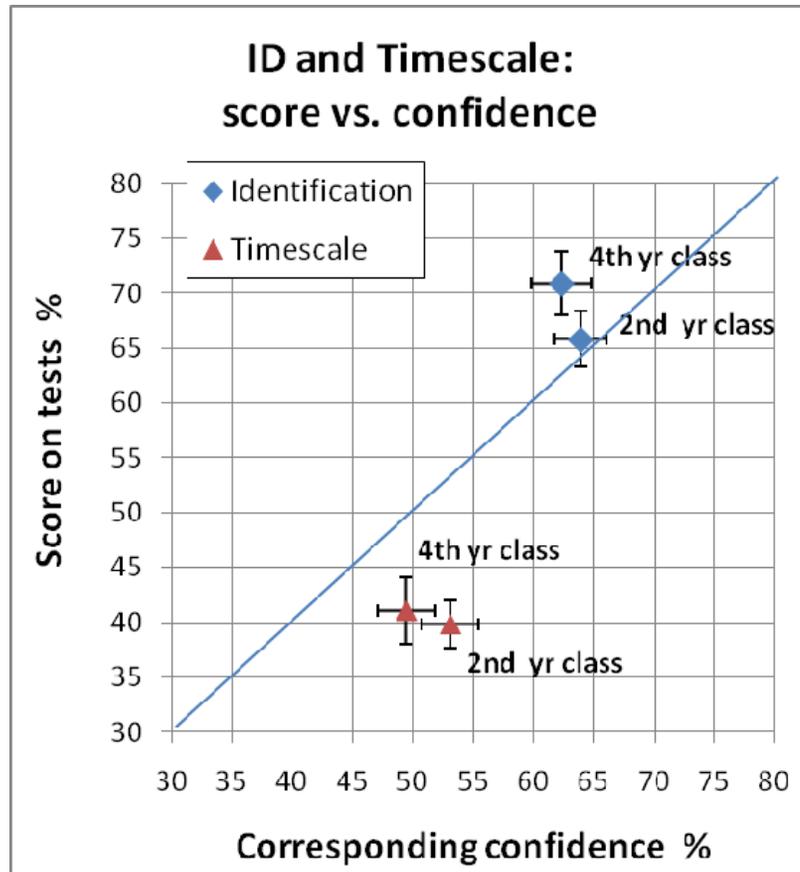
ID	1. a) What type of feature is this? _____
Confidence	b) How confident are you that you recognized the type of feature that is present in the image? <20%      20-40%      40-60%      60-80%      >80%
Timescale	c) How long did this feature take to form? Choose the <b>BEST</b> answer. a) days or less b) years c) 100s of years d) 10s of 1000s of years e) 100s of 1000s of years or more
Confidence	d) How confident are you in your estimation of the time the feature took to form? <20%      20-40%      40-60%      60-80%      >80%

2. Next image is shown (total of 12 images used).
3. Eight Geo-Time questions at the end.

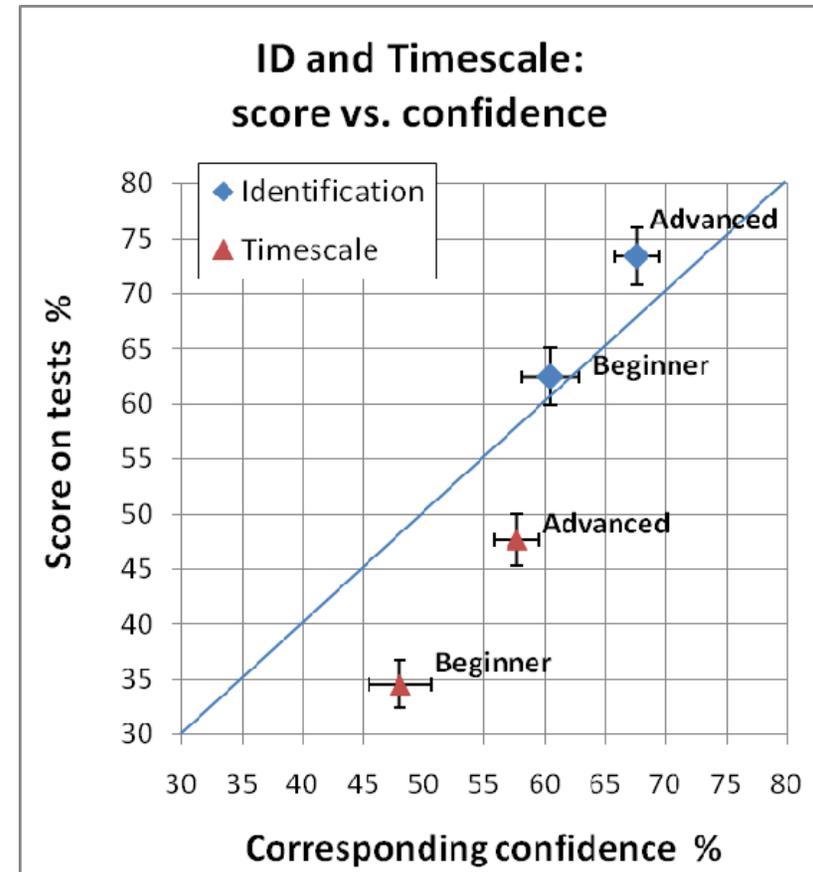
# Initial LIFT deployment

- Two geoscience courses: 2<sup>nd</sup> yr. and 4<sup>th</sup> yr.  
(N = 71 and 25)
- Geoscience majors (9 not geoscientists in 4<sup>th</sup> yr).
- 30 mins. / paper-based / marked by the researcher.
- Demographics recorded:  
gender, age, major, prior geology courses taken.

# LIFT results: by class.



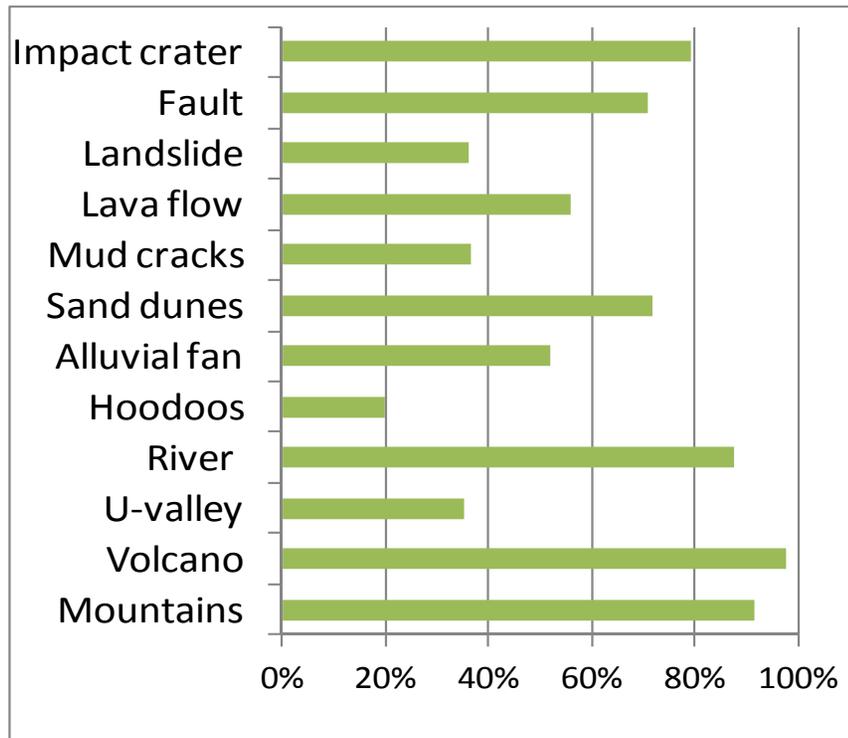
# By experience.



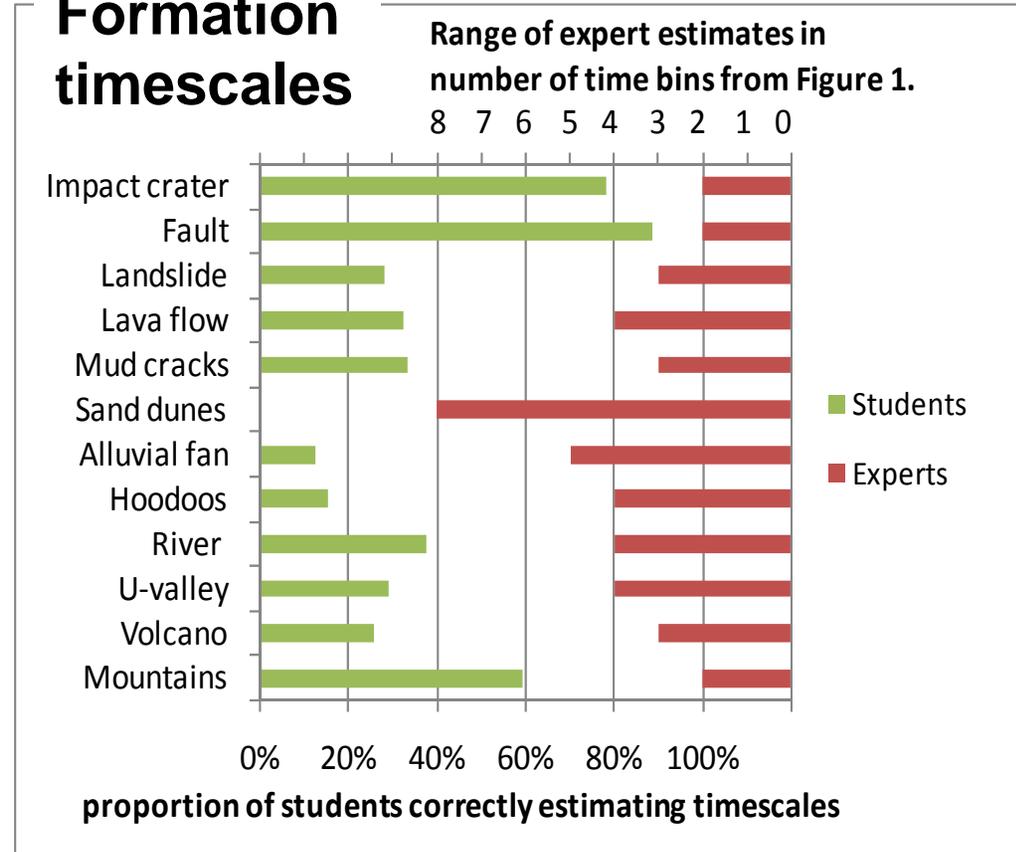
- Diverse geoscience classes: *class year* NOT a good indicator of *geoscience ability*.
- Correlation between knowledge of *geologic time* and *landscape formation times*
- ALL students: - Good at recognizing landscapes.  
- LESS good at estimate formation times.
- Lower scores correlate with lower confidence. (more later...)

# Overall: Percent of all students who were correct

## ID (sorted by timescale)

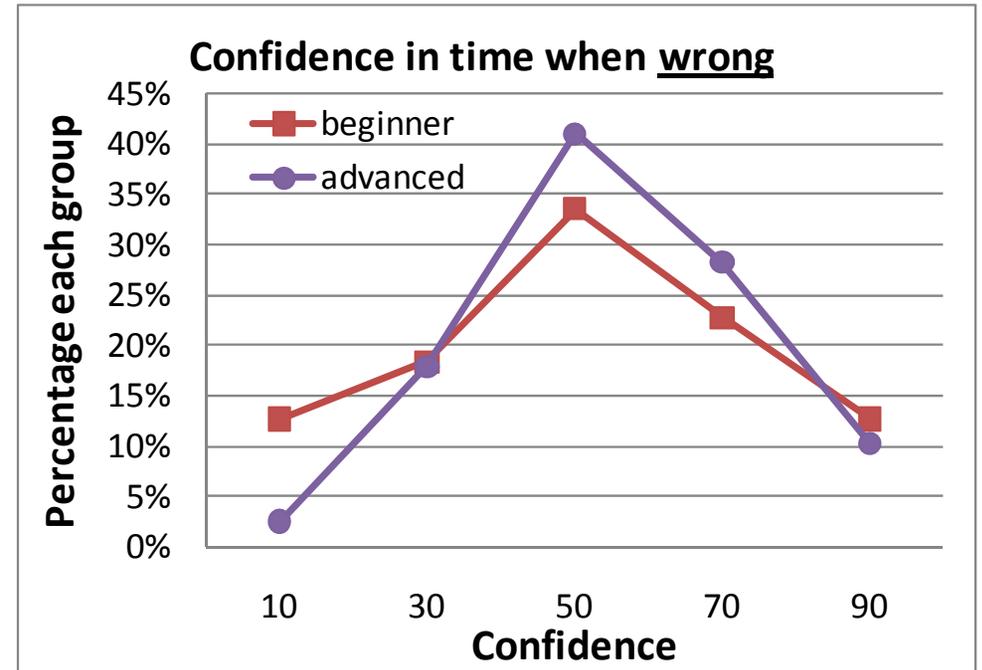
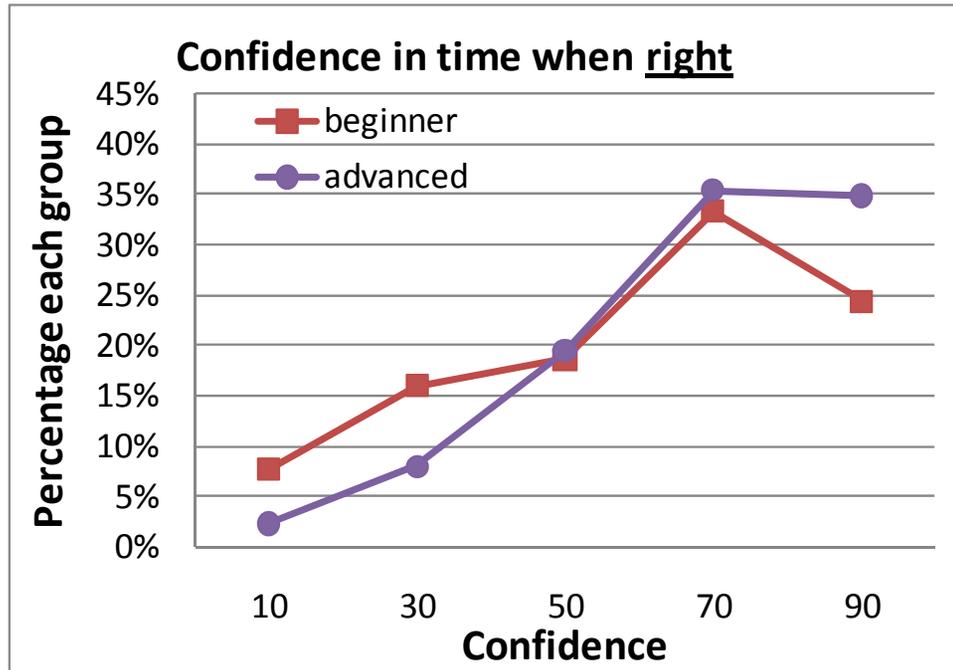


## Formation timescales



- ID knowledge not related to formation times
- Timescales less well recognized.
- Very short and very long timescales known better.
- Experts also were variable with intermediate timescales.
- What implications for geo-science classes ???

# Confidence in formation times (correct landscape ID).



- **Advanced:** more certain than **beginners** when right.
- **Beginners:** confidence is “flatter”, regardless of right or wrong.

*Do metacognitive skills simply improve as expertise grows?*

# Confidence

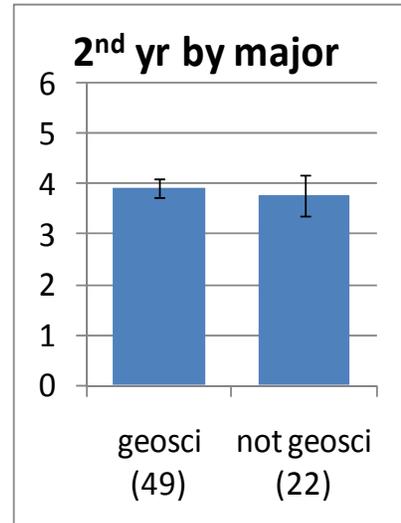
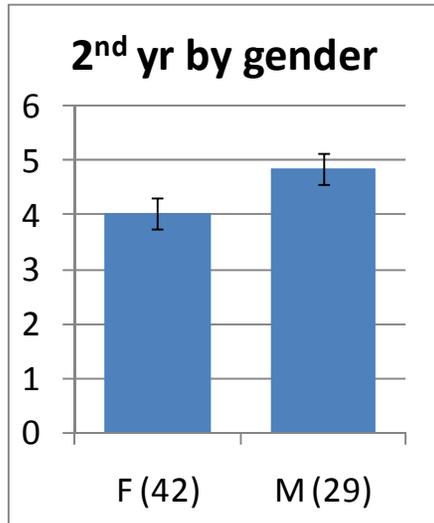
- For **ID** – correctness & confidence are correlated.
- For **timescales**:
  - When correct, advanced students seem more confident than beginners.
  - With wrong, beginners seem more likely to choose the lowest confidence category.
- Are near-graduates “overconfident” ?
- Small numbers; still needs thought.

## LIFT results – gender (all students)

- Overall difference in **I.D.** scores and **timescale** scores was insignificant.
- BUT
  - **Advanced students:** No gender difference.
  - **Beginners:**
    - Males slightly more correct AND confident for both ID and timescale estimates.
    - Females slightly more “un-confident” when “wrong”  
i.e slightly more self aware.

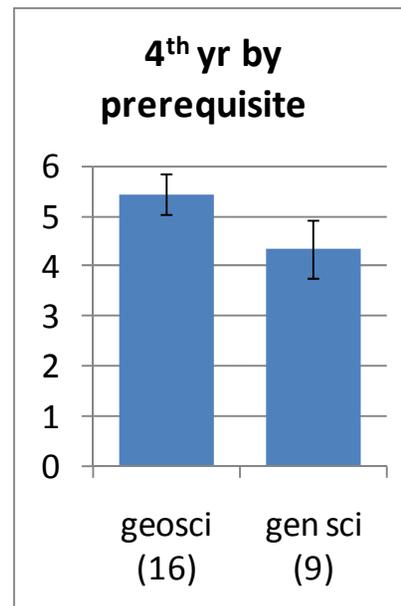
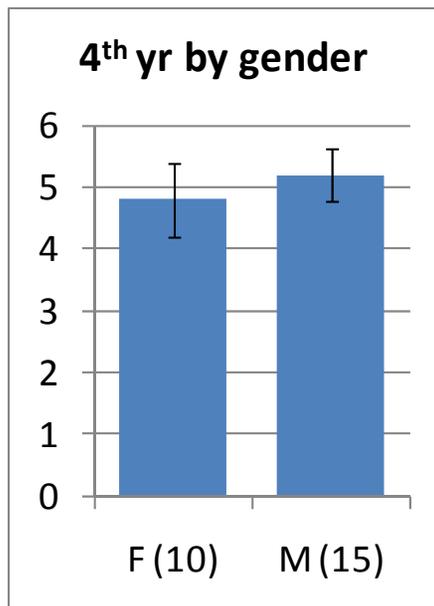
# Geological time scores by gender & prior knowledge:

Regarding knowledge of geological time:



**Evidently, at 2<sup>nd</sup> yr level:**

- Slight effect of gender.
- Nil effect of major.



**Evidently, at 4<sup>th</sup> yr level:**

- Little effect of gender,
- Some effect of prerequisite.

# Comments so far:

- These data provide an initial window into ...
  - Comparing *types* of knowledge about **geological time**.
  - Degree of *agreement among experts* about **landscapes**.
  - Impact of students' *background* in diverse courses.
  - Development of *metacognition* (confidence) in the context of geological time and process rates.
  - Priorities for teaching various types of knowledge & skills.
- Lessons: assessing geoscience learning ...
  - Is context dependent.
  - Requires various types of *validated* instruments.
  - Is challenging 😊

# Conclusions

- The two theses are at:
  - <https://circle.ubc.ca/handle/2429/23321>
  - <https://circle.ubc.ca/handle/2429/6655>
- Uploaded to Teaching Time “Assessments”
- Questions and discussion?

## Thanks to:

- Students who participated.
- Faculty who contributed time, advice and expertise.
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- Colleagues at Colorado University.