

Measuring novices' field mapping abilities using an in-class exercise based on expert task analysis



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Outline:

- 1) Overview of study
 - A) Objectives
 - B) Oliver Field School
- 2) Study design and methods
 - A) Expert task analysis
 - B) Student modeling exercise
 - C) Exercise solutions
- 3) Results and Implications
- 4) Conclusions



Oliver Field School May 2010

Study Objectives:

1. Develop a model of expert-like behavior: use it to improve field teaching methods.
2. Based on expert-model, design and implement an in-class exercise to assess expertise in students.
3. Assist students in mastering the process of field mapping more effectively and think creatively in 3D in the field.



Oliver Field School May 2010

Oliver Field School:

- Two-week field school
- Numerous bedrock mapping exercises



- Most importantly:
 - Captive audience!
Let's study how the students think!

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exercise

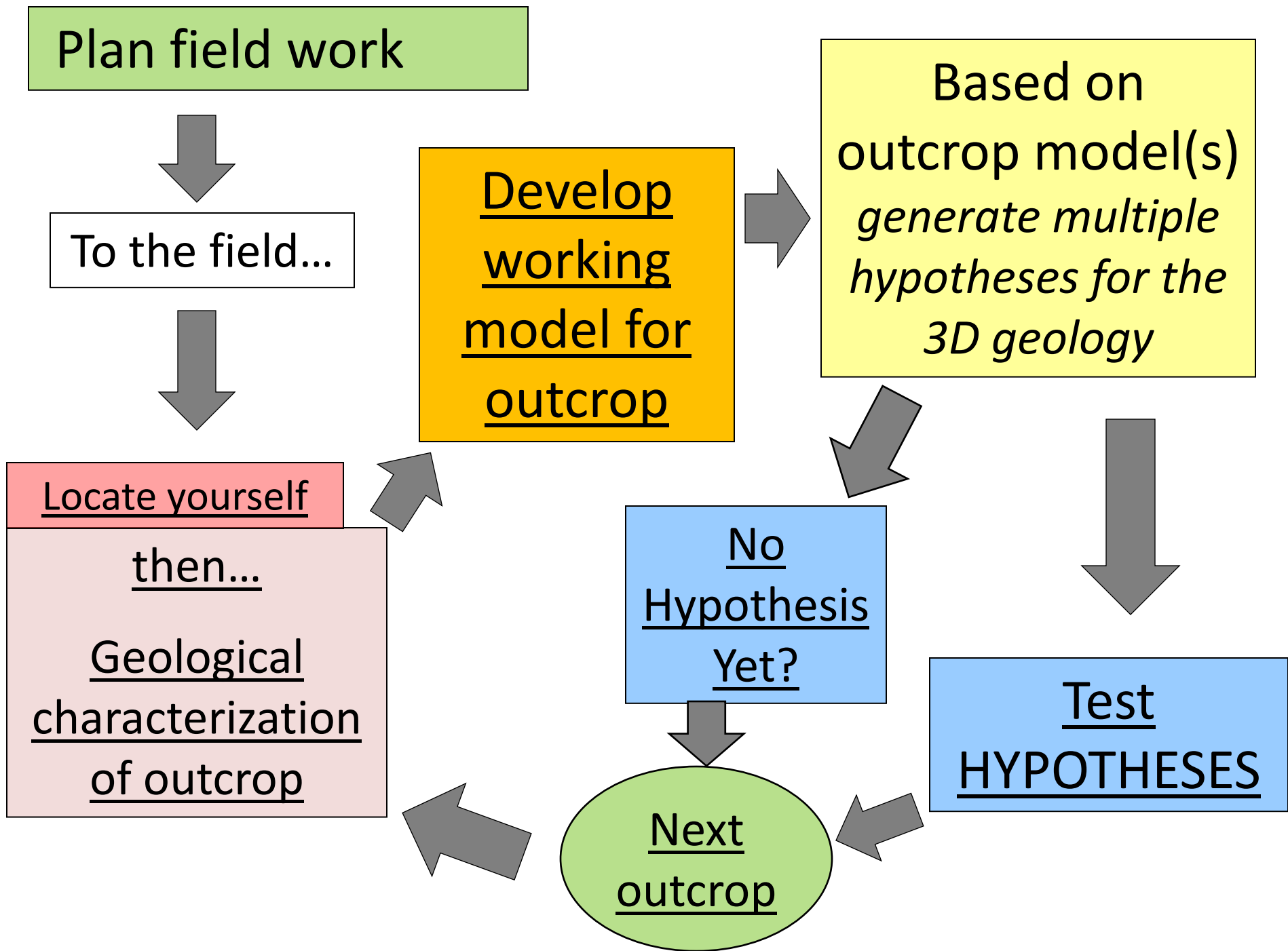
C) Exercise solutions

3) Results and Implications

4) Conclusions

What does an expert geologic mapper DO?





Plan:
*define purpose of exercise, background reading,
equipment and safety preparation (days to weeks)...*

To the field...

Locate yourself in
the field then...

Geological
Characterization of
Outcrop:

- *Lithostratigraphy*
- *Structural elements*
- *geometry*
- *cross-cutting relationships*

Interpretation of
geological
relationships
observed in outcrop:
*i.e. develop a working
model for the outcrop*

No
Hypothesis
Yet?

Go to
next
outcrop

Each loop reduces uncertainty and reveals more of the geological complexity (be it large or small)

**E
X
P
E
R
I
E
N
C
E**

Based on outcrop model(s) how might you expect to “fill-in” the geology over the rest of the map area?
i.e. from outcrop model → generate multiple hypotheses for the 3D geology (lithostratigraphy, structural elements, geometry, cross-cutting relationships) of the whole map area

EXPERIENCE

Test HYPOTHESES
*i.e., which outcrop should you visit next to best test your multiple hypotheses.
[initially very few constraints]*

**Confirmed by UBC
colleagues and by
surveying 46
mapping experts at
GSA (Denver 2010)**

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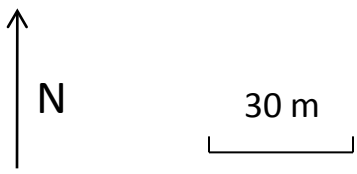
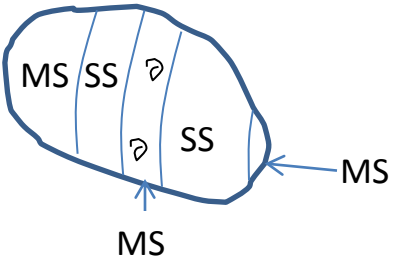
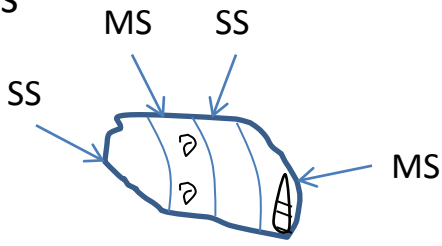
4) Conclusions

Does model
development
exercise show
expert-like behavior
in students?

- 45-minute paper-based exercise (on bus up to field school!)

- Paired students up
- Instruction:
Develop as many
“possible” models as
you can.

Day 1 – two outcrops



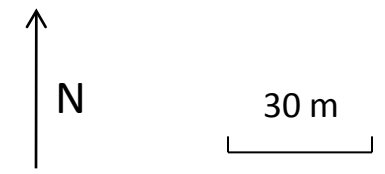
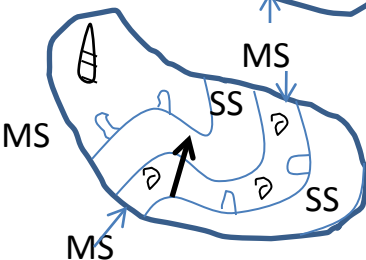
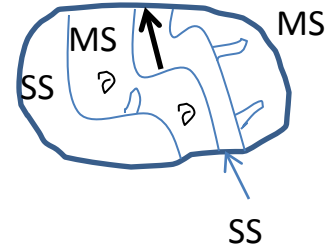
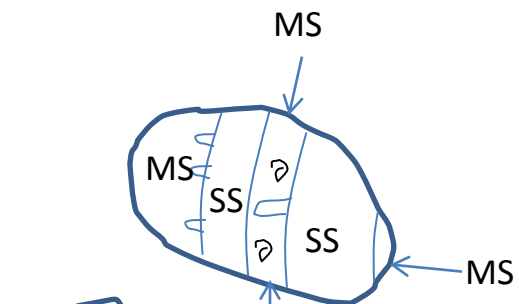
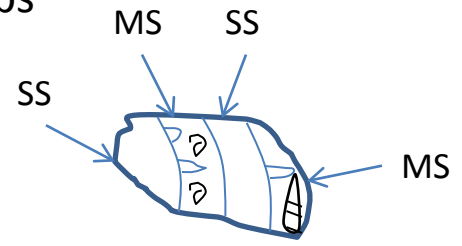
- Key**
- MS – Mudstone
 - SS – Sandstone
 - ☞ Fossil Clam
 - ☞ Marine Fossil

Name 1:

Name 2:

<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>	<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>
<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>	<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>
<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>	<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>

Day 2 – four outcrops



- Key**
- MS – Mudstone
 - SS – Sandstone
 - ☪ Fossil Clam
 - ☪ Marine Fossil
 - ☪ Burrow cast (up↑)
 - ↗ Dip Direction

Name 1:

Name 2:

Brief (1-2 words) Explanation:

Sketch possible relationship:

Brief (1-2 words) Explanation:

Sketch possible relationship:

Brief (1-2 words) Explanation:

Sketch possible relationship:

Brief (1-2 words) Explanation:

Sketch possible relationship:

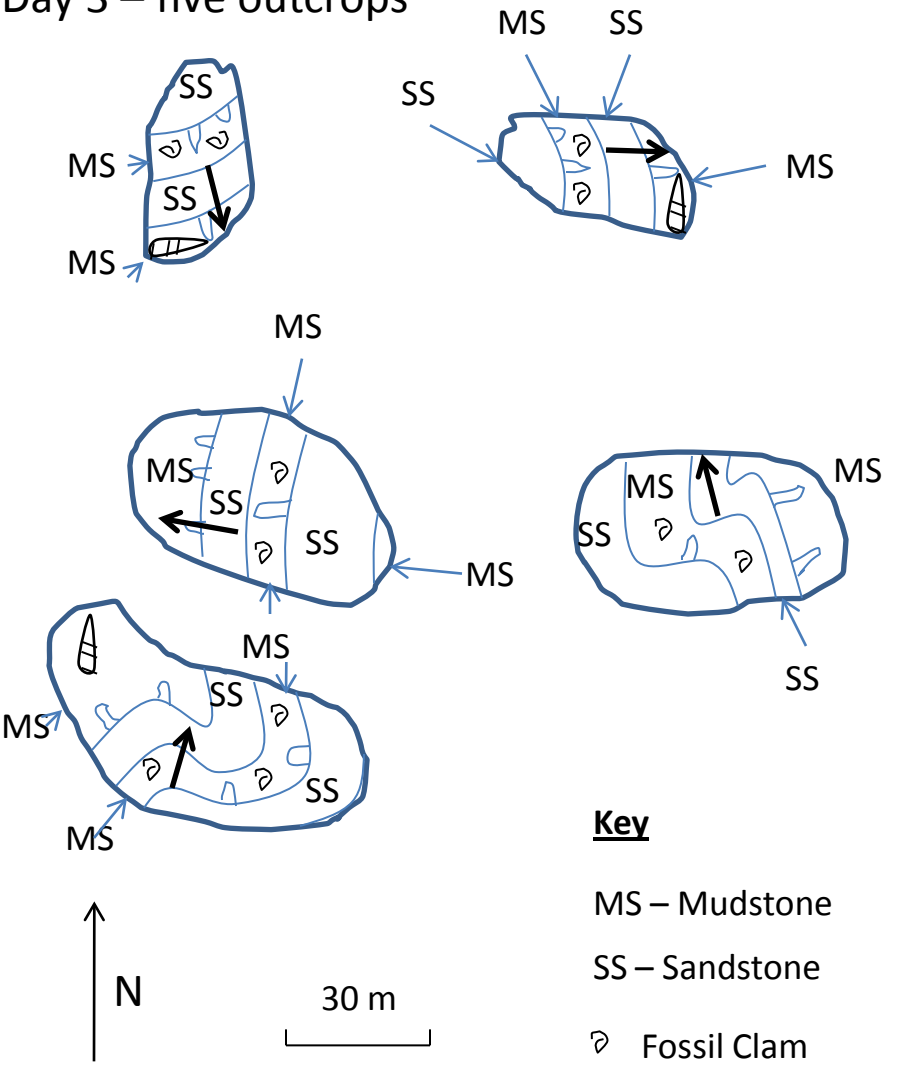
Brief (1-2 words) Explanation:

Sketch possible relationship:

Brief (1-2 words) Explanation:

Sketch possible relationship:

Day 3 – five outcrops



- Key**
- MS – Mudstone
 - SS – Sandstone
 - ☪ Fossil Clam
 - ☪ Marine Fossil
 - ☪ Burrow cast (up↑)
 - ↗ Dip Direction

Name 1:

Name 2:

<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>	<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>
<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>	<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>
<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>	<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>

How do we assess students on a scale from novice to expert via this exercise?

Experts: generate multiple possible models. None are impossible.

Novices: generate models but likely very few and/or include numerous impossible models.

Day 2 – four outcrops

Key

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- Dip Direction

Brief (1-2 words) Explanation: <i>folded anticline</i> Sketch possible relationship: <i>folded</i>	Brief (1-2 words) Explanation: <i>young fold (anticline) (folded)</i> Sketch possible relationship: <i>folded anticline</i>
Brief (1-2 words) Explanation: <i>open or small fold</i> Sketch possible relationship: <i>fold</i>	Brief (1-2 words) Explanation: <i>syncline (fold)</i> Sketch possible relationship:
Brief (1-2 words) Explanation: Sketch possible relationship:	Brief (1-2 words) Explanation: Sketch possible relationship:

Name 1:

Name 2:

Methods:

- Total number of possible models generated
- Ratio of Possible to Impossible Models (PM/IM+1)

Example Student Model – Assessment is blind

Day 2 – four outcrops

Key

- MS – Mudstone
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- ☉ Fossil Clam
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- 👤 Burrow cast (up ↑)
- ↗ Dip Direction

Name 1:

Name 2:

<p>Brief (1-2 words) Explanation: <i>folded (anticline) &</i></p> <p>Sketch possible relationship: <i>tilted</i></p>	<p>Brief (1-2 words) Explanation: <i>large fold (anticline folds)</i></p> <p>Sketch possible relationship: <i>(tilted anticline)</i></p>
<p>Brief (1-2 words) Explanation: <i>prev. or. model (S) with faults</i></p> <p>Sketch possible relationship: <i>fault</i></p>	<p>Brief (1-2 words) Explanation: <i>Syncline (fold)</i></p> <p>Sketch possible relationship:</p>
<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>	<p>Brief (1-2 words) Explanation:</p> <p>Sketch possible relationship:</p>

1 point

1 point

And no "impossible" models

Total = 2

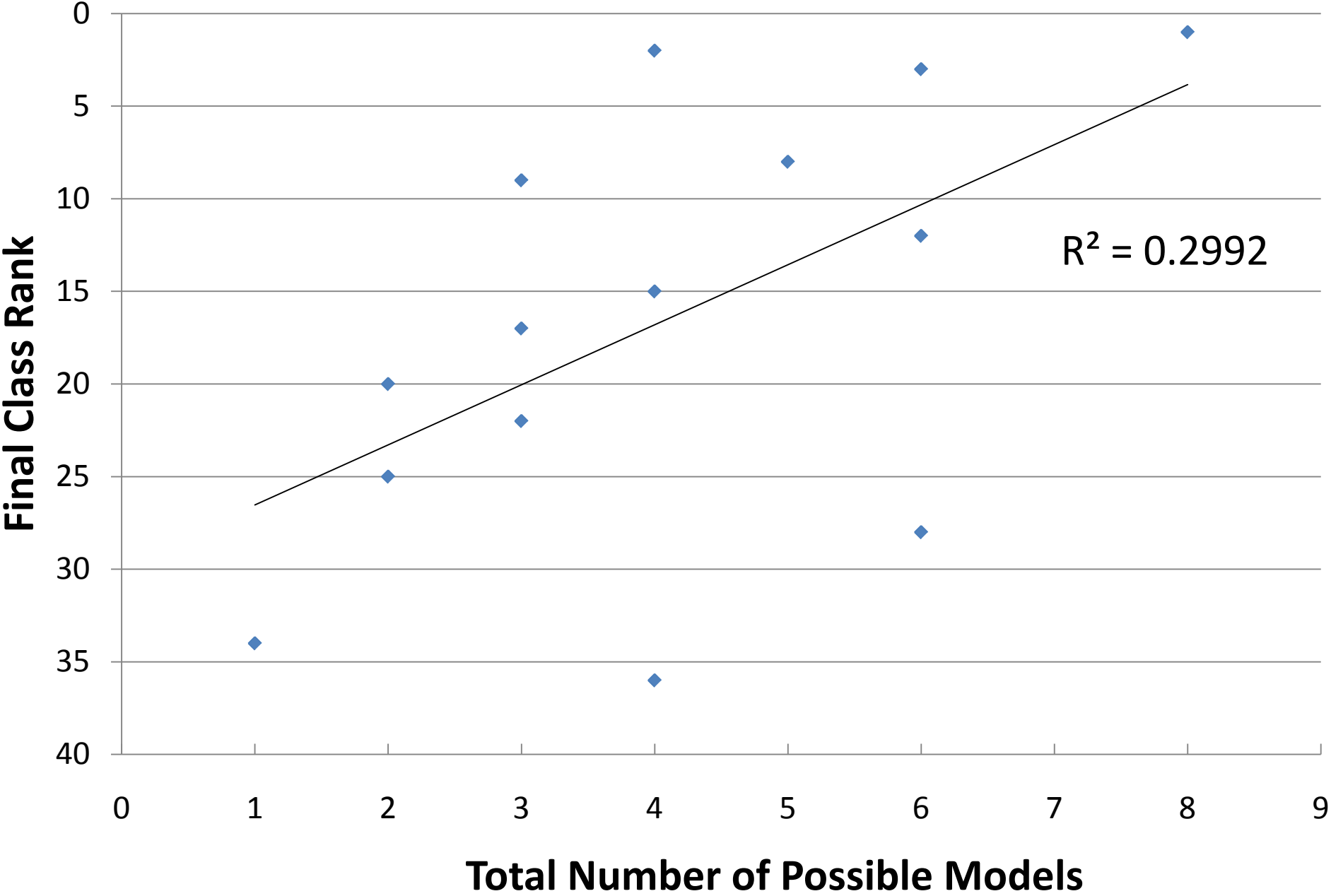
Results:

Plotted Student Class

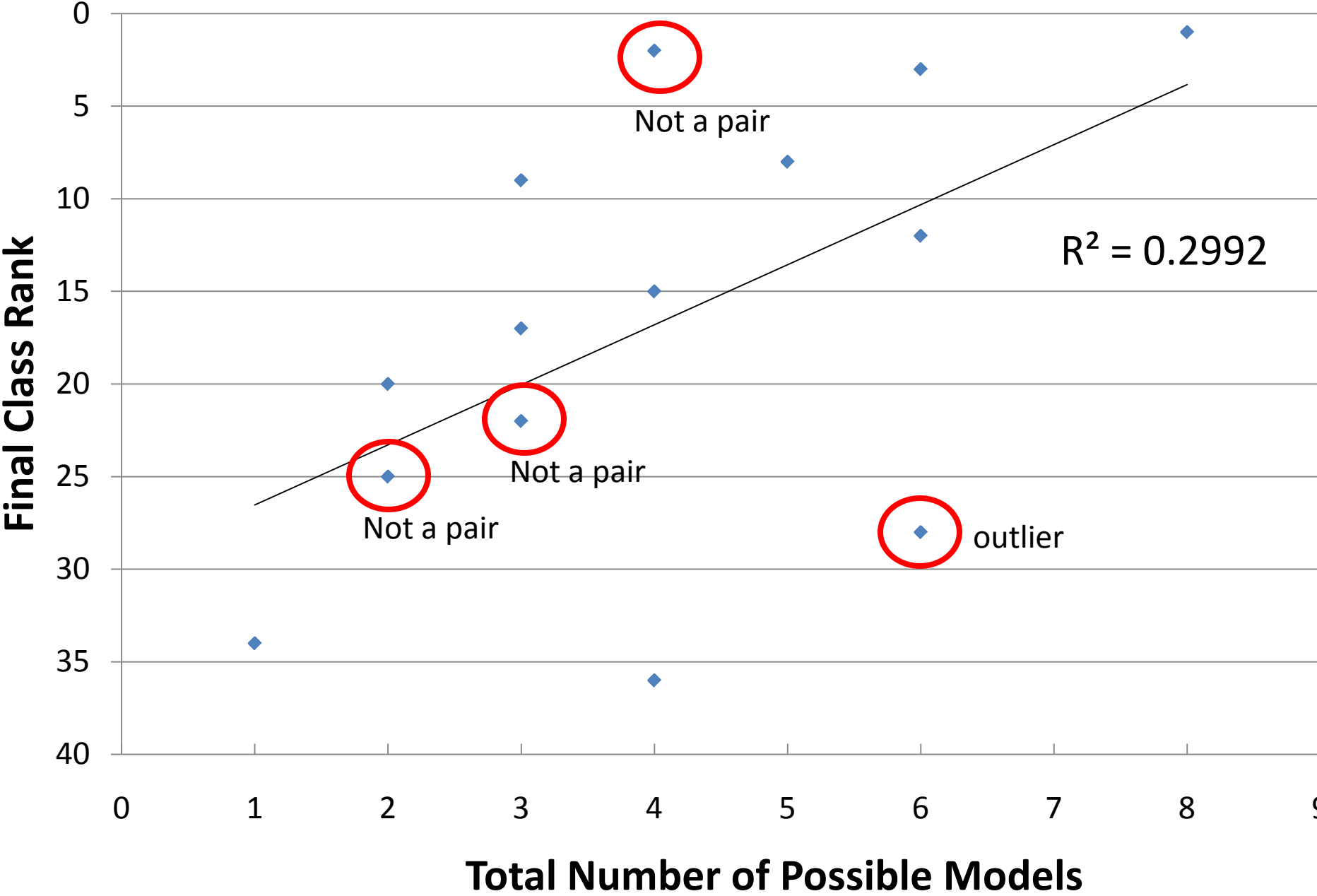
Rank against Number of

Possible Models

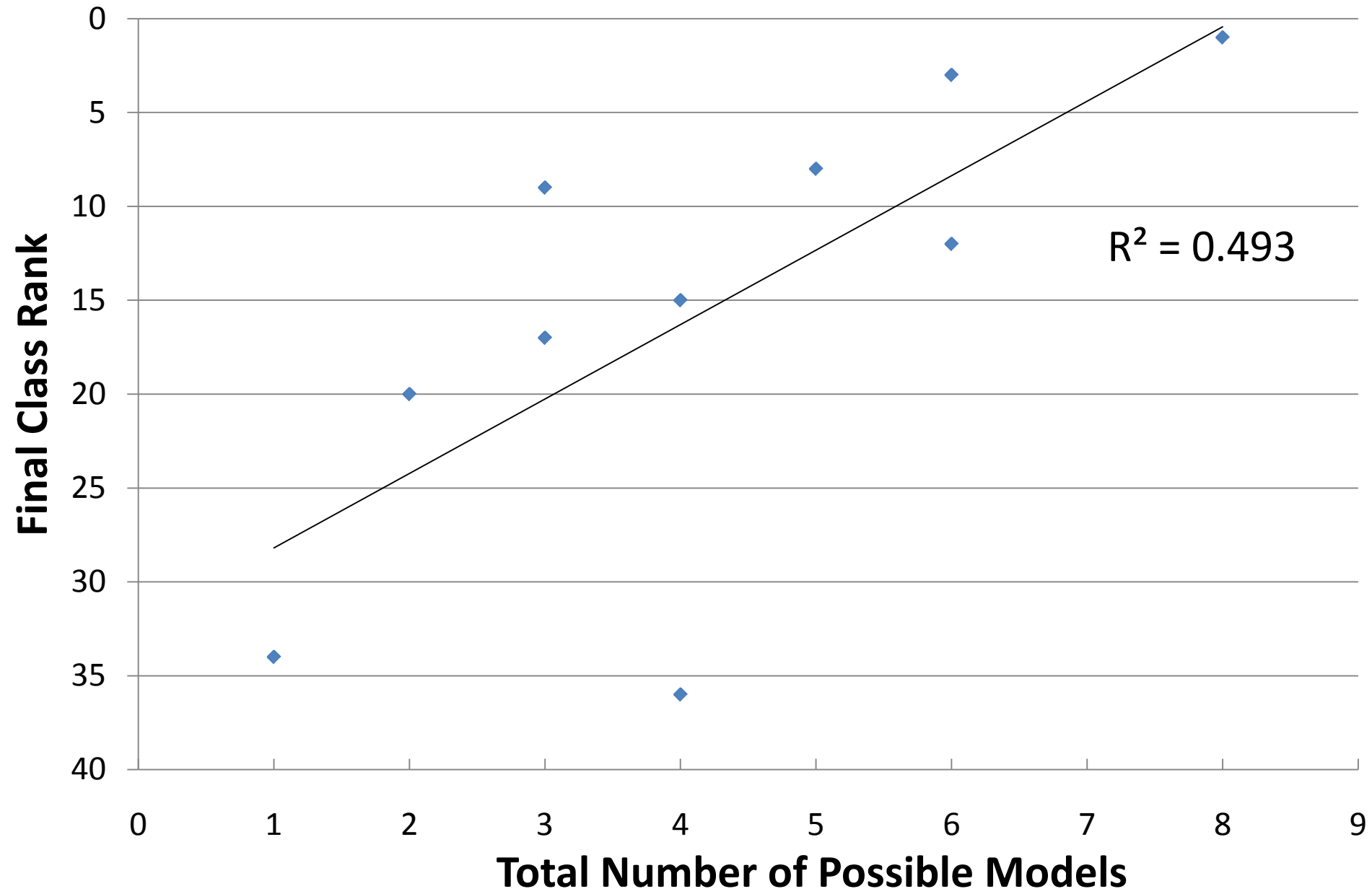
Final Class Rank vs. Number of Possible Models (all data)



Final Class Rank vs. Number of Possible Models (all data)



Final Class Rank vs. Number of Possible Models (outliers removed)



Conclusions:

- The exercise is one measure of expertise in one aspect of field mapping (model creation) and it appears to predict which students will have more trouble with field camp and which will have less.
- Can use this information to target parts of mapping expertise and provide to students focused, appropriate feedback and opportunities to practice.

Next Year:

- Will use exercise as an individual (not paired) pre- and post-assessment and associate it with a lesson on model creation. Post-test will have isomorphic data.