

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

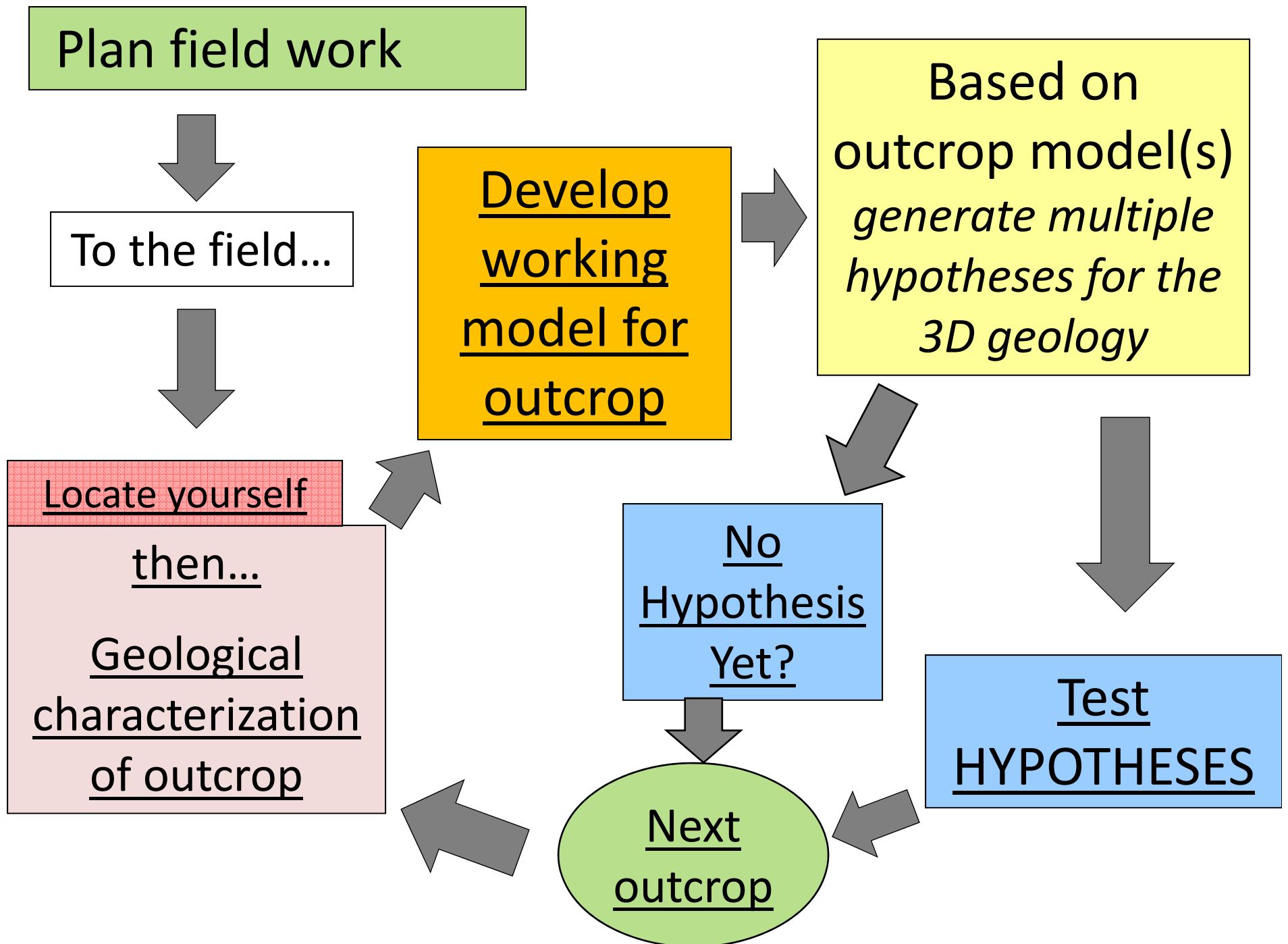
C) Exercise solutions

3) Results and Implications

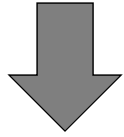
4) Conclusions

What does an
expert
geologic
mapper DO?

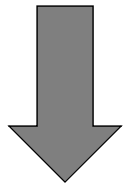




Plan field work



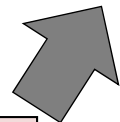
To the field...



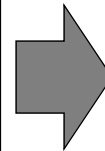
Locate yourself

then...

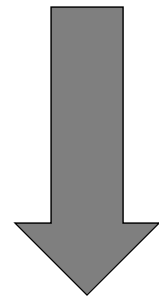
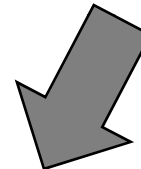
Geological
characterization
of outcrop



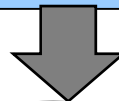
Develop
working
model for
outcrop



Based on
outcrop model(s)
generate multiple
hypotheses for the
3D geology

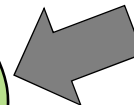
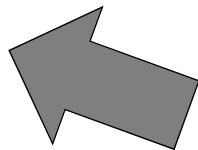


No
Hypothesis
Yet?



Test
HYPOTHESES

Next
outcrop



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

Plan field work

To the field...

Locate yourself

then...

Geological
characterization
of outcrop

Develop
working
model for
outcrop

Based on

outcrop model(s)
generate multiple
hypotheses for the
3D geology

Hypothesis

Yes

Test

HYPOTHESES

Next
outcrop

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C) Exercise solutions

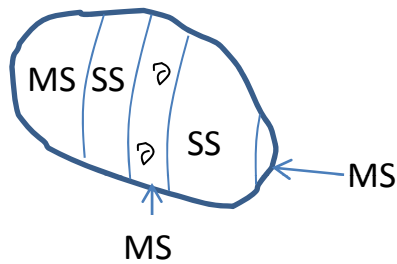
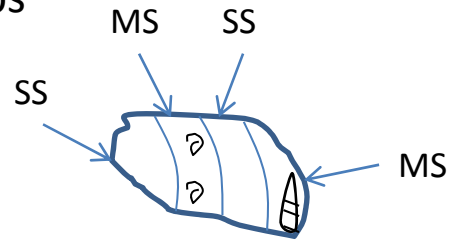
3) Results and Implications

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

Brief (1-2 words) Explanation:

Sketch possible relationship:

Brief (1-2 words) Explanation:

Sketch possible relationship:

Brief (1-2 words) Explanation:

Sketch possible relationship:

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Sketch possible relationship:

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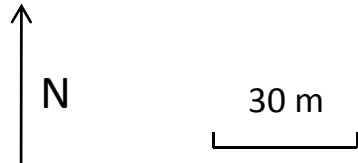
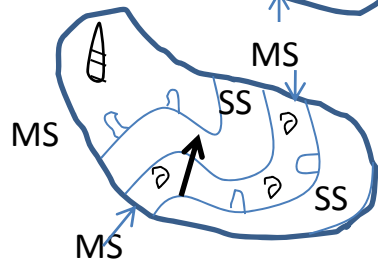
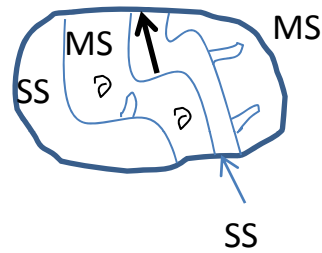
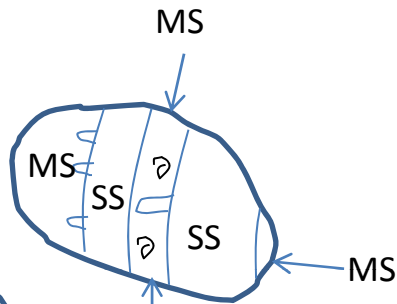
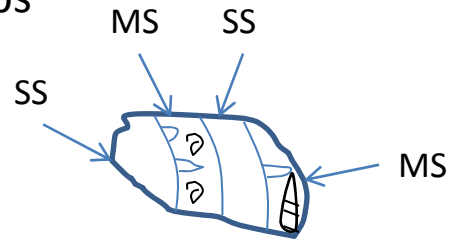
Brief (1-2 words) Explanation:

Sketch possible relationship:

Name 1:

Name 2:

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:

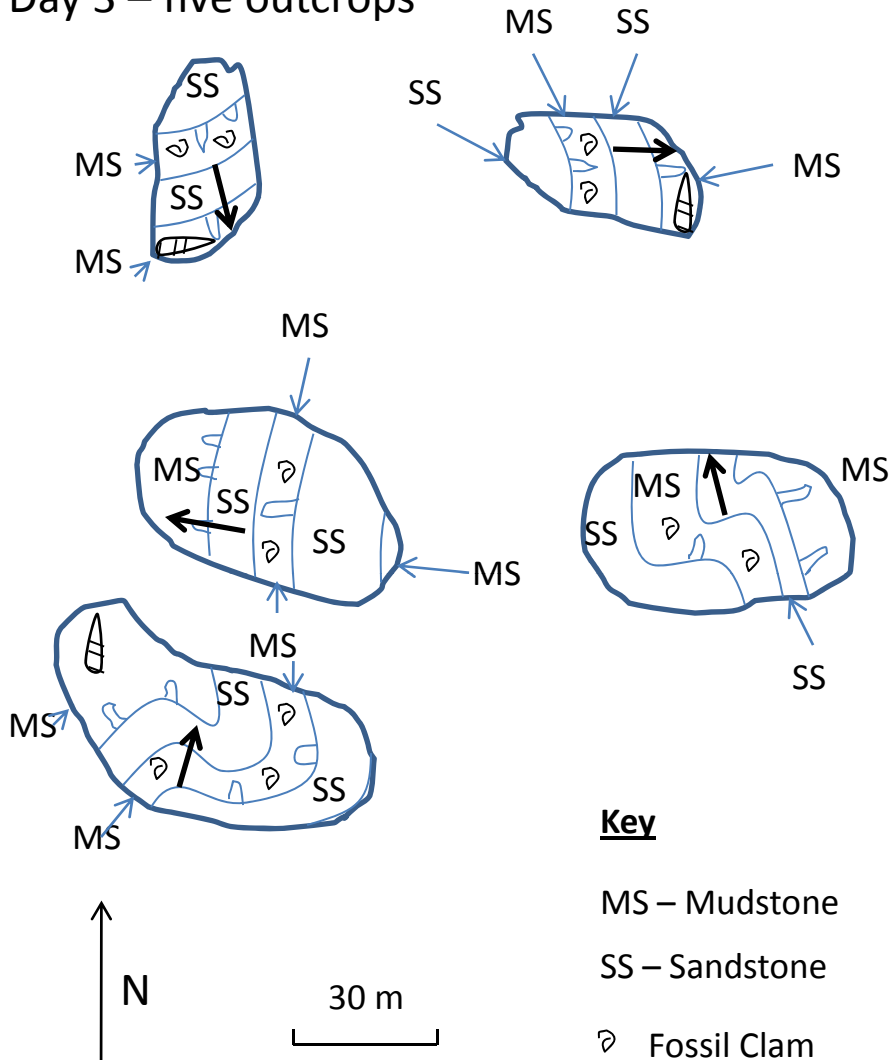
Brief (1-2 words) Explanation:

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:

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:

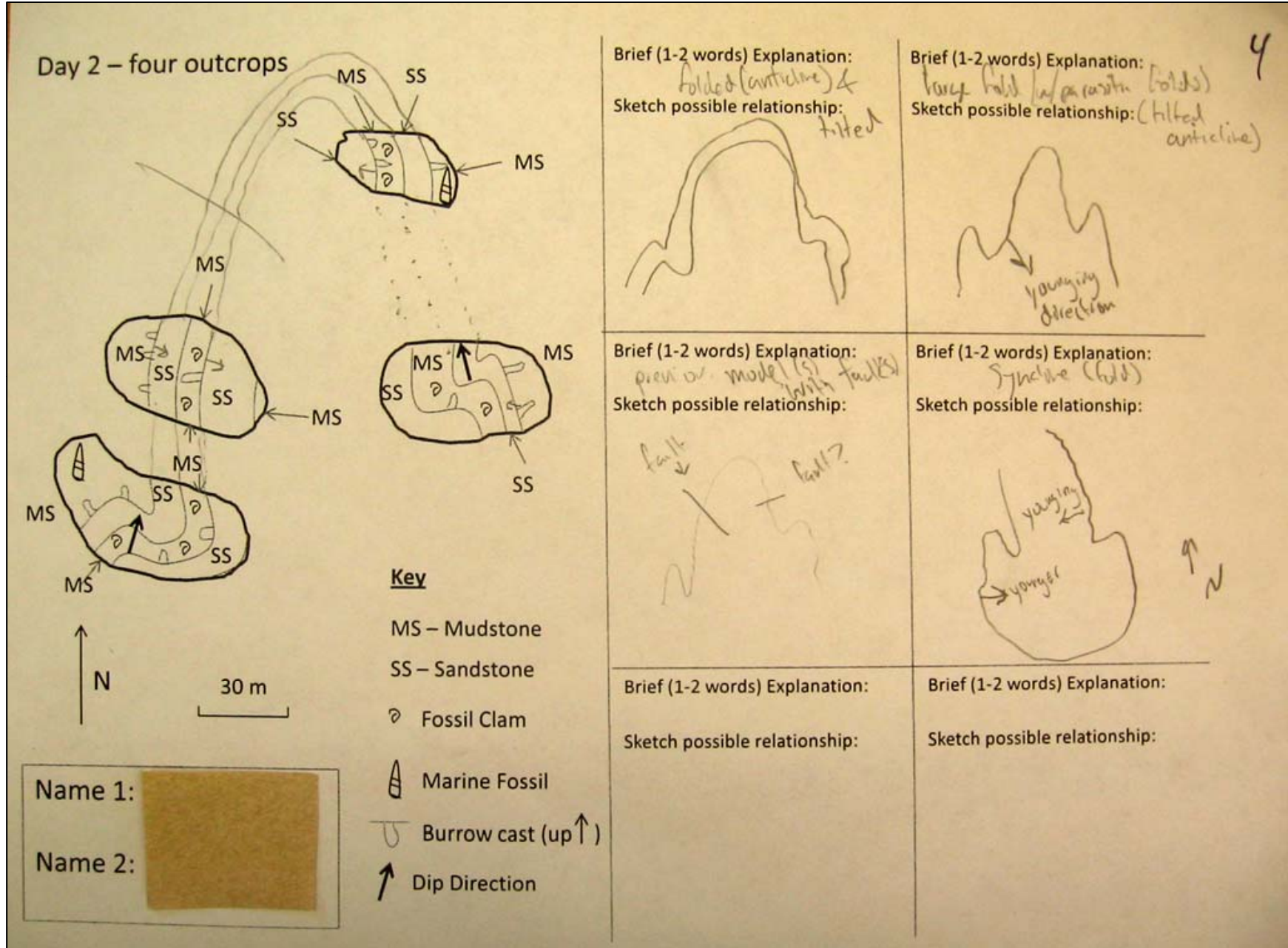
Brief (1-2 words) Explanation:

Sketch possible relationship:

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Sketch possible relationship:

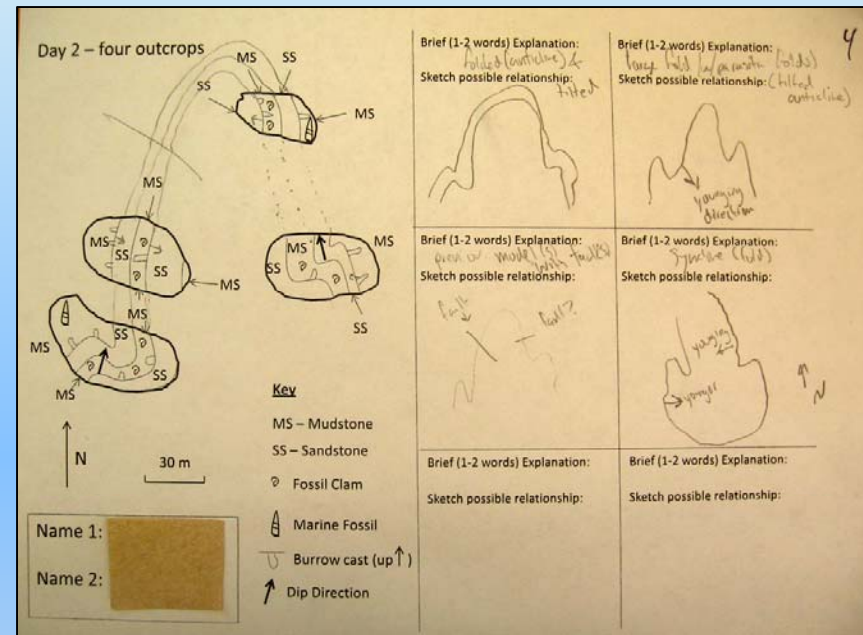
Example Student Model



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.



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
 SS – Sandstone
 ☉ Fossil Clam
 Marine Fossil
 Burrow cast (up ↑)
 Dip Direction

Name 1:
 Name 2:

<p>Brief (1-2 words) Explanation: <i>folded (anticline) & tilted</i></p> <p>Sketch possible relationship: </p>	<p>Brief (1-2 words) Explanation: <i>large fold (anticline) & parasitic folds</i></p> <p>Sketch possible relationship: <i>(tilted anticline)</i></p> <p style="text-align: right;">4</p>
<p>Brief (1-2 words) Explanation: <i>prev. model (SS) with faults</i></p> <p>Sketch possible relationship: </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

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Example Student Model – Marking is blind

Results: Plotted Student Class Rank against Number of Possible Models

Day 2 – four outcrops

MS – Mudstone
SS – Sandstone
∅ Fossil Clam
A Marine Fossil
B Burrow cast (up ↑)
↑ Dip Direction

Brief (1-2 words) Explanation:
Sketch possible relationship:

Brief (1-2 words) Explanation:
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Sketch possible relationship:

Brief (1-2 words) Explanation:
Sketch possible relationship:

Name 1:
Name 2:

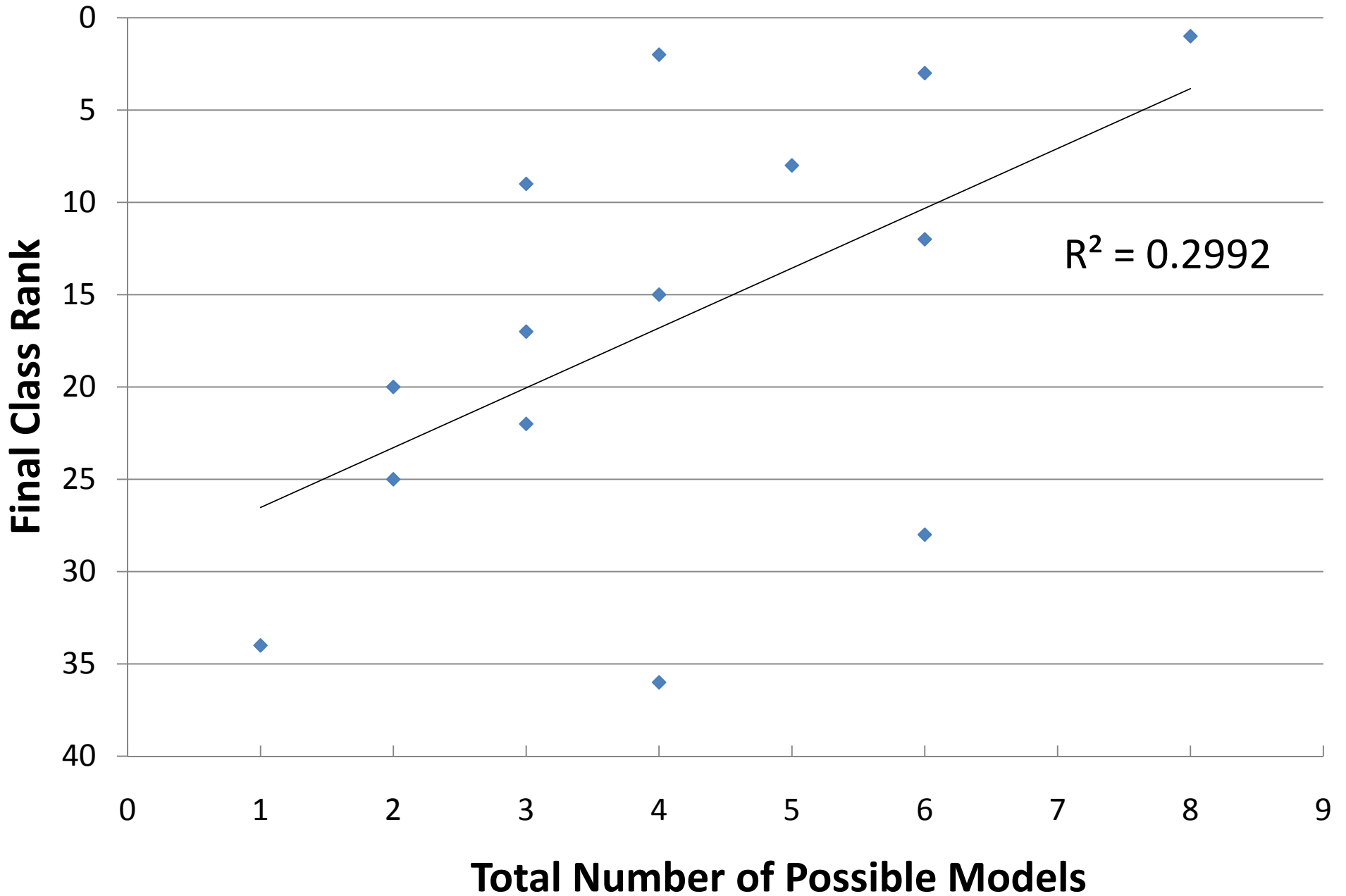
1 point

1 point

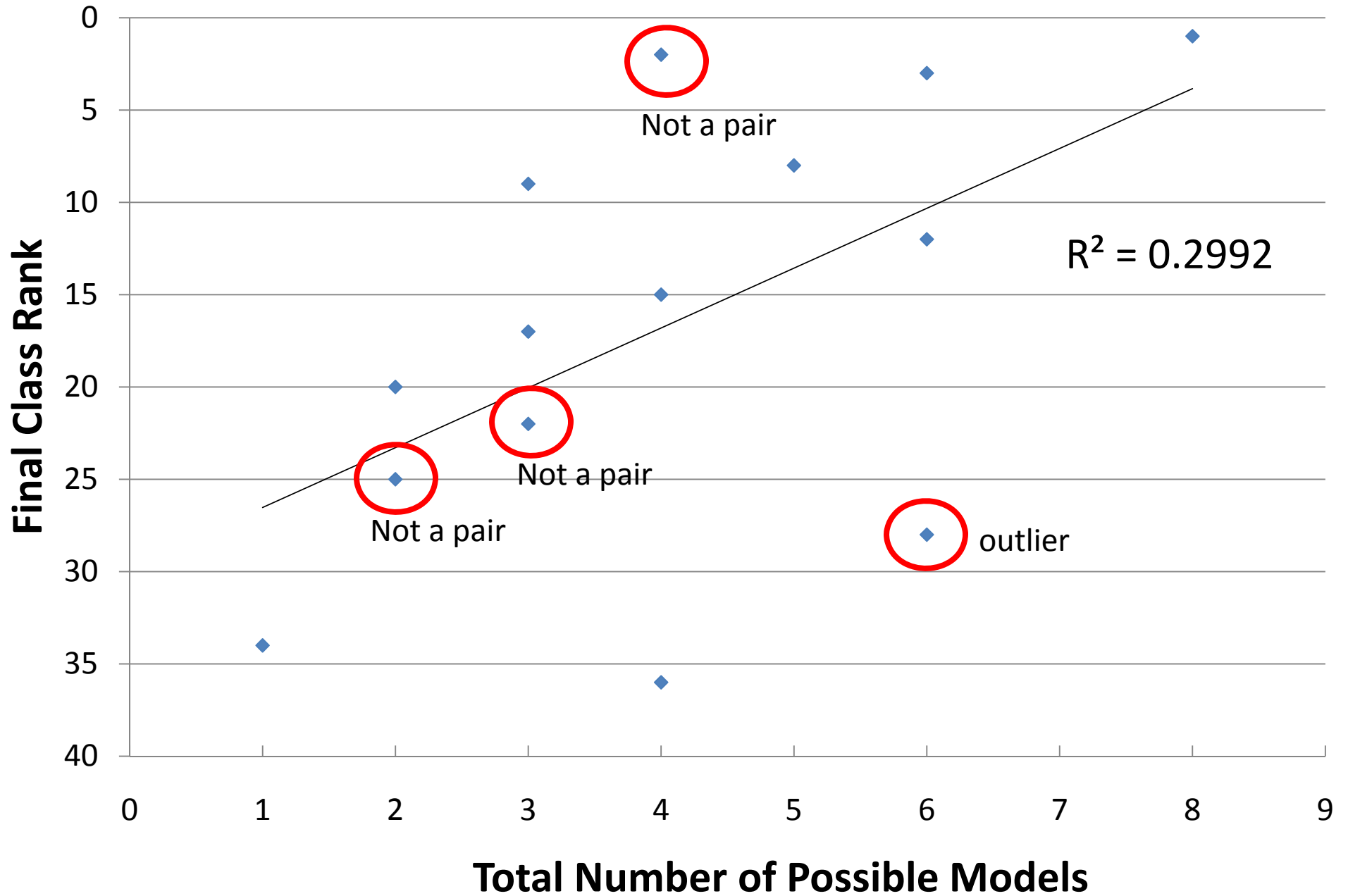
And no impossible models

Total = 2

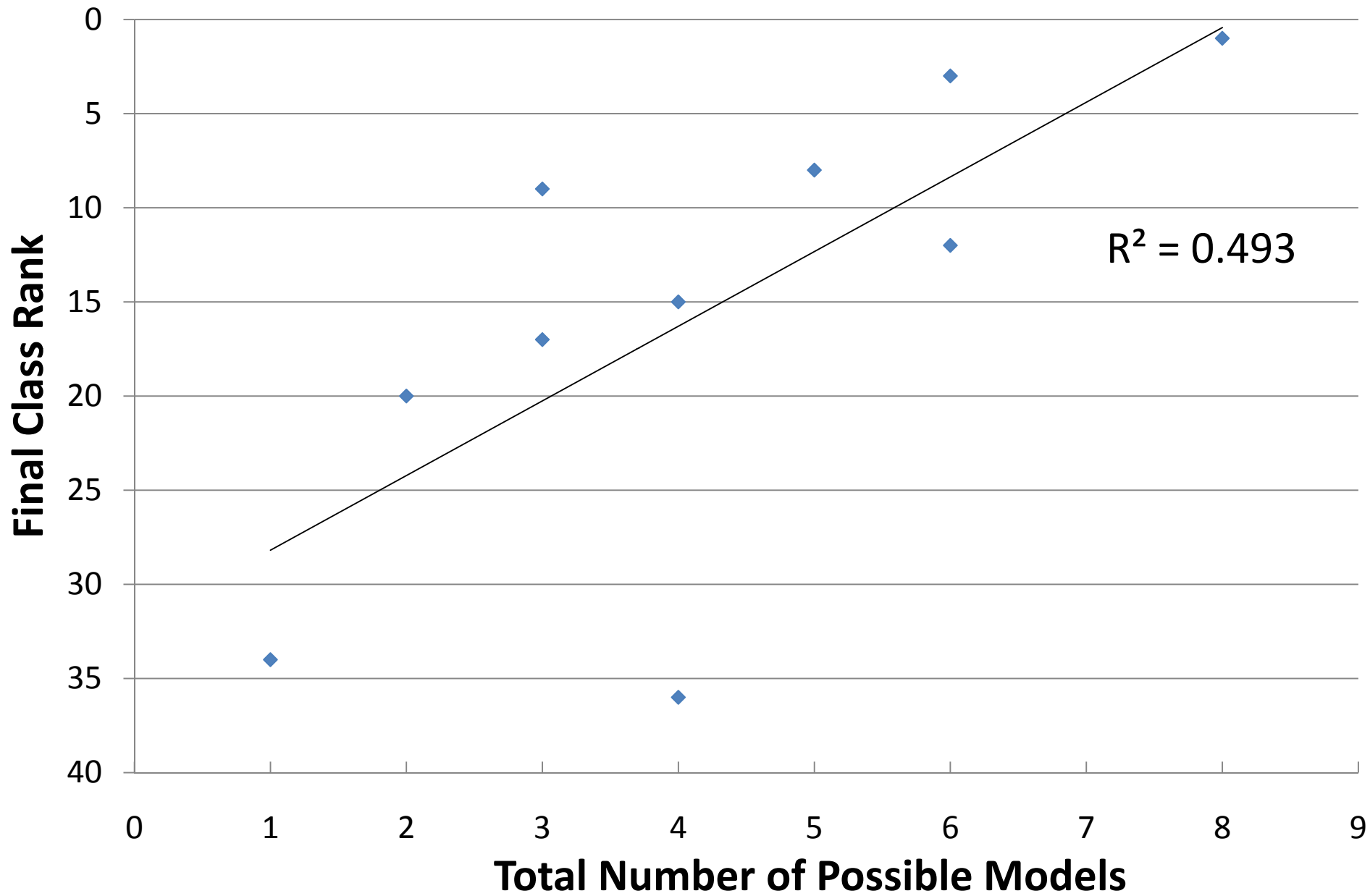
Final Class Rank vs. Number of Possible Models (all data)



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



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



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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.



Fin.

Questions?