A Structure for Mastering Stereonets in Structural Geology

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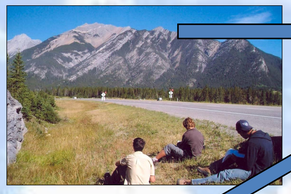
My motivation?

Personally was challenged

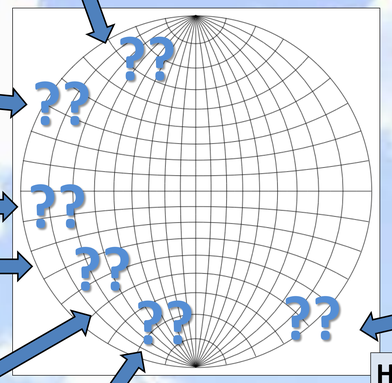
Most dramatic transformative moment of my voyage to professional geologist involved a hand in a bowl

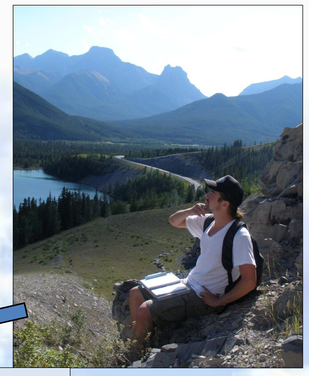
How to plot these on that?



How to teach?

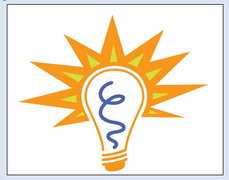
What works?





How to learn?

Expected lots of these



Personal joy witnessing transformative moments

Here – use student voice to understand what really works and what does not

Methods

4 years of exam marks – question averages

Questionnaire

Part A: Likert Scale

-RCL = Reported Confidence Levels (on specific skills)

-rank helpfulness of instructional techniques

Part B: Open ended questions about transformative moments

Participants – 11 students over two years (out of total 40)
Anonymous participation due to MRU HREB ethical constraints
Course – Introductory Structural Geology at Canadian public undergraduate university

Threshold Concept "Akin to a portal"

(Meyer & Land 2006)

- transformative
- integrative
- probably irreversible
- possibly troublesome

Table One: Ranking Stereonet skill level

Skill	Rank	Exam marks	RCL
Pole to Plane	Basic	84; 93%*	
Line of Intersection	Basic	92; 94%*	4.7
Apparent Dips	Basic	86.5; 89.4%*	4.4
Rake	Basic	89.6; 90.5%*	4.8
Paleocurrent	Basic (Intermediate)	83.2%**	3.7
Oblique Traverse	Intermediate	63.2; 69.2%*	3.9
Fold Analysis	Intermediate	73.8%**	
Fault Plane Diagrams	Intermediate	74.2%**	
Unplunge/unfold Fold	Advanced (midterm); Intermediate (final)	57.8; 68.2%*	
Unconformities	Advanced	49.5; 56.3%*	3.6

Basic skills – averages >80%, RCL >4.3; Intermediate skills – averages 79.9 to 60.0, RCL <4.0; Advanced skills -averages <60%, RCL <4.0 (RCL = reported confidence level). *where two numbers; first – average on midterm, second average on final. ** where one number; average on only final

Table Two: Ranking helpfulness of Instructional Techniques

Instructional Technique	Rank	Average; Likert Value	Model Step??
Class Exercise	Very	4.6	1, 2, 3, 4, 5
Lab Problems	Very	4.7	1, 2, 3, 4, 5
Old exam / quiz problems	Very	4.6	3, 4, 5
Group Work	Very	4.4	4
Lectures	Helpful	3.8	1, 2, 3, 4, 5
Instructor Explanations	Helpful	3.8	1, 2, 3, 5
Reading Textbook	Least	2.8	1, 2, 3
Textbook Problems	Least	2.5	1, 2, 3, 5

Likert scale question asked participants to rank the helpfulness of different Instructional techniques where 5 was extremely helpful and 1 was not helpful.
Very > 4.0; Helpful 4.0 to 3.0; Least helpful < 3.0

All

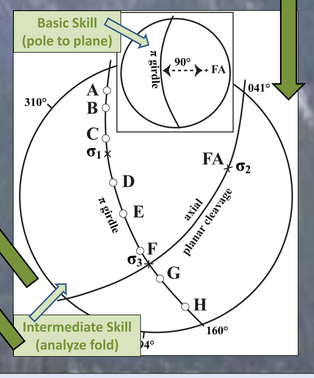
Proposed Model (transferable to all challenging topics)

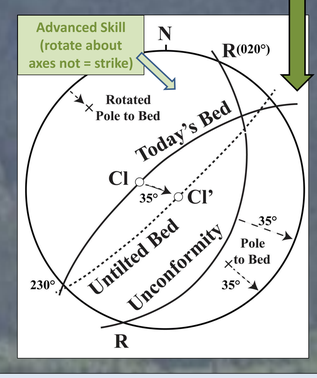
1) Introduction to conceptual knowledge,
2) Learn skills in an accretive manner,
3) Use stereonet to solve different problems,
4) Collaborate with peers, and
5) Use stereonet to construct geoscience schematic models

Not rocket science!! (but not in literature)

#2

#3





Predicted Results?

*Students like group problem solving & hands on activities

*Students don't like to read, especially complex material such as Structural Geology

*Students don't like techniques that they perceive as not being helpful (e.g. textbook problems versus old exam/quiz problems)

*Practice, practice, practice!! (step #3)

*Basic skills involve 1-2 steps; while some advanced skills involve rotations

Surprising Results?

*Students did not recognize that some textbook problems were very similar to the old exam/quiz problems

*Not all rotation skills were "advanced"; there was no natural break between some intermediate and advanced skills

*No evidence for transformative moments as per the following comments that imply that the participants gradually gained the necessary skills:

'Probably doing apparent dips. I just started to really get it'

'During the 1st stereonet lab; finding TD etc from given information and relating to cross-sections'

'The large lab with stereonets. Through doing class examples and then the lab forced you to figure out what was going on.'

Conclusions?

*Structural Geology courses are taught in good scaffolding sequences

*Participants were likely "high initial spatial ability", one possible reason for a lack of transformative moment testimonials

*Proposed model provides a good framework for teaching challenging subjects

*As professors, never forget that what we perceive as being simple are not necessarily simple for the novice student!