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Exemplifying the Mixing of Research Methods: Triangulating on student drawings.

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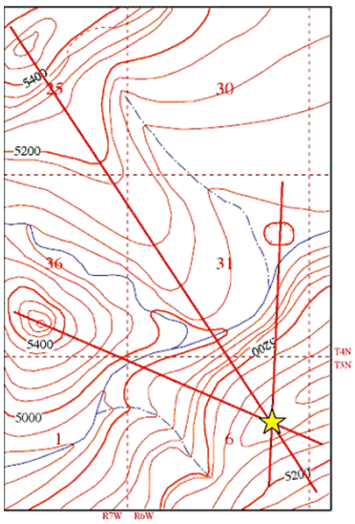
Method effects

- How you collect and analyse data shapes and determines the results you get
- Every method is imperfect and so you get method effects
- Results may be due to the method you use
  - Data may cluster because of how it is collected not what it actually measures

Triangulation: Multiple & Mixed Methods

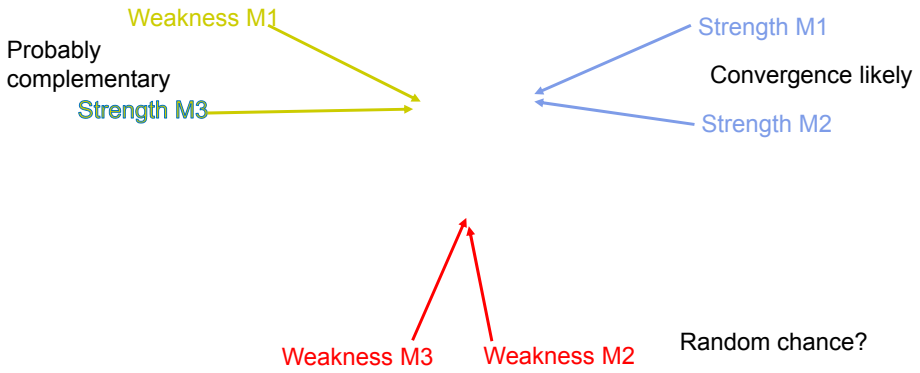


- Find location of unknown object by approaching it in different ways from known sites
- Metaphor for multiple and mixed methods research
  - Multiple approaches to examine common phenomenon

Method Effects in Quantitative Research

- NOT new in Quantitative Research
- Need to check or control for method effects by using multiple methods
  - Validation tools
    - Multi-trait, multi-method analysis
    - Multi-battery factor analysis
  - The common traits should stand out regardless of method used

Triangulation



Goal: non-overlapping weaknesses

Multi-Trait, Multi-Method Analysis

		Method 1		Method 2	
		Trait A	Trait B	Trait A	Trait B
Method 1	Trait A	(reliability)			
	Trait B	MonoM HeteroT	(reliability)		
Method 2	Trait A	**HeteroM MonoT**	HeteroM HeteroT	(reliability)	
	Trait B	HeteroM Hetero T	**HeteroM MonoT**	MonoM HeteroT	(reliability)

If traits exist across methods then **HeteroM+MonoT** should be stronger than other correlations

Campbell, D. T. & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin 56,* 81-105.

MTMM Analysis: Self-Rating, Teacher-Rating, & Ability

	Monotrait Heteromethod			Heterotrait Monomethod			Heterotrait Heteromethod		
Measure	1	2	3	1	2	3	1	2	3
1. SILSER		.26	.22	.50				.25	.21
2. Teacher Rating of Independence			.09		.73				.36
3. ESA:IS Test Performance						na			

These are Average Correlations.

What Conclusions can you draw?

Brown, G. T. L. (2005). Student information literacy: Psychometric validation of a self-efficacy report. *Psychological Reports, 96,* 1044-1048.

Multi-Battery Factor Analysis

	Joint Factor Analysis				Multi-battery Factor Analysis			
Scales	I	II	III	IV	I	II	III	IV
18. Student Accountability	**.66**	.35	-.04	-.08	.19	**.50**	.01	.02
14. Describe	**.63**	-.44	-.15	.04	-.32	**.35**	-.04	.17
13. Valid	**.56**	-.41	.17	-.14	-.31	**.35**	.10	-.03
17. School Accountability	**.56**	-.13	.09	-.26	-.13	**.43**	.20	.00
20. Academic	**.47**	.05	-.20	-.24	.04	**.48**	.08	.28
7. Surface	**.45**	.09	-.12	-.10	-.01	**.50**	.04	-.00
21. Technological	**.42**	-.15	-.31	-.01	-.11	**.35**	-.07	.29
9. Internal	**.40**	.07	-.06	-.21	.02	**.24**	.13	.05
10. Bad	.13	**.79**	-.02	.01	**.77**	.11	.00	.01
11. Ignore	-.03	**.72**	-.02	-.09	**.83**	.04	.08	.28
16. Improve Learning	.39	**-.60**	-.13	-.09	**-.43**	.14	.11	.17
15. Improve Teaching	.38	**-.53**	-.30	.08	**-.34**	.18	-.03	.17
12. Inaccurate	-.11	**.40**	-.31	-.09	**.49**	.04	.08	.28
8. External	.20	**.36**	.13	.04	**.23**	.17	-.00	-.17
1. Nurturing	-.10	-.07	**-.67**	-.20	.00	-.07	.07	**.39**
6. Deep	.02	-.05	**-.64**	-.10	.00	-.02	.05	**.37**
22. Humanistic	.24	.05	**-.51**	.16	.04	.15	-.12	**.38**
2. Apprenticeship	.09	-.10	**-.39**	-.35	-.05	.09	.16	**.27**
4. Social Reform	-.04	.03	-.02	**-.78**	.06	.00	**.72**	.09
5. Development	-.06	-.11	-.29	**-.67**	-.02	.04	.27	**.29**
19. Social Reconstruction	.20	.11	.09	**-.55**	.03	.12	**.59**	-.07
3. Transmission	.36	.07	.09	**-.53**	-.01	**.46**	.20	-.15

Same Method

Same Trait

Method Effect

Trait Effect

Brown, Gavin T L (2007). An introduction to multi-battery factor analysis: Overcoming method artefacts. *Practical Assessment Research & Evaluation, 12*(7). Available online: http://tinyurl.com/2bt7fl

Mixing Methods

- More than using multiple methods
  - Multiple methods within quantitative reduces error and increases validity
- Mixing methods means using both qualitative and quantitative appropriately mixed depending on multi-faceted nature of problem

Mixing Methods Rationale

- When you want to ask a question that has rarely been asked or has been asked with questionable results.
- When you want the strength of multiple methods for triangulation.
- When some, and only some, of your variables are easily quantifiable at this stage of inquiry.

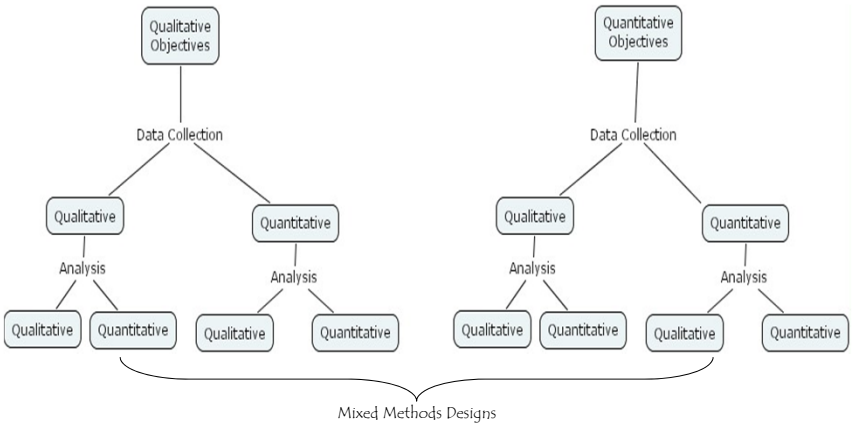
To think about

- Is your problem or interest…
  - Quantities or qualities
  - Take place in a naturally occurring or artificial setting
  - Focused on meanings or behaviours
  - Amenable to an inductive or deductive approach
  - Generalised to cultural contexts or universe of all populations
- If both then need mixing methods design
  - If problem contains both then need both
- Otherwise use multiple methods that don't mix paradigm

Mixing Methods Research

- Mixing methods moderates the competition between methodological paradigms
- Simply adding a second method to a study does not make it good research
- What makes good research is having a rationale for mixing methods and a rigorous implementation technique
  - *How will you overcome method effects so as to be able to integrate results?*

Mixing Methods Designs



Johnson & Onwuegbuzie, 2004, p. 21 Figure 1

Mixed Method Design Options: Status & Timing

	Concurrent	Sequential
Equal Status	QUAL + QUAN	QUAL➔QUAN QUAN➔QUAL
Dominant Status	QUAL + quan QUAN + qual	QUAL➔quan qual➔QUAN QUAN➔qual quan➔QUAL

Johnson & Onwuegbuzie, 2004, p22, Figure 2

Advantages of Mixing Methods

- Reduce bias in the study.
- Help to understand complex issues.
- Addresses the *objectivity-subjectivity* continuum.
- Allows researcher to move back and forth between paradigms to fully understand situation.

Disadvantages of Mixing Methods

- Conflict of paradigms - purist perspective.
  - Can you really work and write using two contrasting paradigms and be close to the truth?
- Works well if you work in a team - one qualitatively grounded, one quantitatively grounded.
- But results from one method may not align with another method

Data alignment across methods

- 26 Teachers completed questionnaires and then interviewed in open-ended, phenomenographic fashion
  - 4 factor scores created for each teacher by questionnaire
  - Interview results reduced to 3 point scale for same factors
- Level of agreement poor
  - 57% of ratings the same;
  - kappa coefficients=-.13; .14; .13; -.11 (around chance)
- Inference: complementary, not consistent results
  - Not corroboration

Harris, L. R., & Brown, G. T. L. (2010). Mixing interview and questionnaire methods: Practical problems in aligning data. *Practical Assessment Research & Evaluation, 15*(1). Available online: http://pareonline.net/pdf/v15n1.pdf.

Investigating the implicit

- How do we find out about the thinking, beliefs, attitudes, opinions, or ideas that people have when:
  - They may never have thought about the topic before (i.e., they don't know what they think)?
  - They don't have language skills sufficient to express their ideas?
  - They are reluctant to tell you their personal thinking (e.g., cultural respect for authority)?
  - They are too shy or too young to express th

Traditionally

- Interview or Survey
  - But both depend on good metacognitive awareness, linguistic skills
  - May result in reflexive results (i.e., responses are a function of the stimulus not really what they think)

Clever Hans the horse was supposedly able to do arithmetic. In 1907, it was found that the horse was watching the reaction of his human observers and stopping his counting when their physical reactions changed.

Observer-expectancy effect

Projective techniques

- Methods that allow a person reveal hidden emotions and internal conflicts.
- Responses content analyzed for meaning.
- From psychoanalytic psychology, which argues that
  - humans have conscious and unconscious attitudes and motivations that are beyond or hidden from conscious awareness.
  - Projective techniques exposed those unconscious elements
- Better called a FREE RESPONSE MEASURE

Strengths

- Diem-Wille
  - pictures, drawings, and metaphors show a person's emotional state of mind much better than verbal definitions or descriptors (p. 119)
    - Diem-Wille, G. (2001). A therapeutic perspective: The use of drawings in child psychoanalysis and social science. In T. V. Leeuwen & C. Jewitt (Eds.), *Handbook of visual analysis* (pp. 119-133). London: Sage.

Strengths

- drawings can be used to identify nuances and ambivalences within a person's belief system
  - Clarebout, G., Depaepe, F., Elen, J., & Briell, J. (2007). *The use of drawings to assess students' epistemological beliefs.* Paper presented at the Biannual Conference of the European Association for Research on Learning and Instruction, Budapest.
  - Clarebout, G., Elen, J., Leonard, R., & Lowyck, J. (2007). Assessing instructional conceptions: A task-based approach. *Educational Research and Evaluation, 13(2), 109 - 125.*

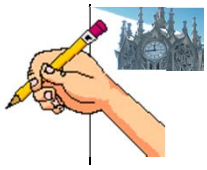
Strengths

- drawing pictures seems to help children recall and express more detail about events they depicted.
- children are generally receptive to drawing, making it a useful 'icebreaking' activity and a potential way of mediating student shyness

Strengths

- Students with low literacy, English language learners, and pupils with certain special needs (e.g. intellectual impairment, speech-language impairment) may particularly benefit from expressing their viewpoints through drawings
  - Wheelock, A., Bebell, D., & Haney, W. (2000a). Student self-portraits as test-takers: Variations, contextual differences, and assumptions about motivation. *Teachers College Record*, ID Number: 10635.
  - Wheelock, A., Bebell, D., & Haney, W. (2000b). What can student drawings tell us about highstakes testing in Massachusetts? *Teachers College Record*, ID Number: 10634.

Draw-a-picture Procedures



- Each person draws a picture by themselves according to instructions (10 minutes enough)
  - Remember it's NOT art class
  - Add a caption to explain the picture
  - This is an ice-breaker or starter for a focus group discussion
  - Sample instructions:
    - Draw a picture of assessment. This picture can be about what you think it is and how it makes you feel. Include a caption below your drawing explaining your drawing.

Draw-a-picture Procedures

- Each person shares their picture with the group and explains what is it about and why they drew it
  - reduces dominance and shyness
- Encourage members to question each other for clarification or to make comments about patterns and similarities between drawings
- Let the members talk

Preparation for Analysis of Drawings and Discussions

- Transcribe discussions
- Give identification code to each participant
- Code & scan pictures digitally
  - Make sure codes match! Use high resolution 300dpi
- Decide on approach to content analysis
  - *A priori* theoretically derived categories (scientific approach)
  - *Emergent* empirically derived categories (grounded theory approach)

Content Analysis

- An empirical (observational) and objective procedure for quantifying recorded 'audio-visual' (including verbal) representation using reliable, explicitly defined categories
  - Bell, 2001 p. 13
- Frequency gives some insight into importance & scale
  - SCoA example
    - Establish the frequencies of words and images within the drawings thought to convey meaning about the students' conceptions of assessment and its purposes…to identify important trends

A priori Analysis of Drawings and Discussions

- Define categories of interest based on prior research questions, literature review, and theories.
- Look for those things.
  - Human behaviour is a function of intentions, purposes, and beliefs➔Look for causal reasons & effects
  - Practices usually have multiple purposes➔Look for goals
  - Processes have personal, affective, and social consequences➔Look for effects at multiple levels
  - Processes interact with other processes in an environment➔Look for connections to other meaningful & important processes
- If you know your field you should know already what is important to look for

Emergent Analysis of Drawings and Discussions

- Develop categories from content present in the data (emergent analytic)
  - Drawings—objects drawn or thematic elements across multiple pictures
  - Discussions—words, phrases, ideas that are said across multiple participants
- Focus is on content patterns across the participants
  - Phenomenographic analysis of variations in categories
  - **Weakness**: if it isn't in the data that you have does that mean it doesn't exist?

Coding procedure

- Split data into two halves and assign each to an independent analyst **or**
- Do ½ and use 2nd ½ for validation of schema
- Create a list of all the objects, symbols, and key words visible in the pictures as possible 'sub-categories'.
- Create the least number of subcategories needed to account for all items.
  - For example, rather than having separate sub-categories for all drawn school supplies (e.g., pen, pencil, ruler, eraser), group into one because of similarities in their function and content (i.e., stationery).

Coding procedure

- Group sub-categories into higher order grouping categories.
  - For example, 'sub-categories' of school supplies, desks, blackboards, computers, and other similar objects ➔common category of 'physical environment artefacts'.
- Minimise number of categories with fewer than 5 members in them
- Develop codebook of categories
- Code 2nd half or get another analyst to independently code the drawings

Sample Student Drawing of Assessment

- What do you see in the drawing?
  - Type of assessment
  - Physical artefacts
  - Teacher
  - Emotions
  - Outcomes

Estimating Similarity of Coding

- Cohen's (1960) kappa (κ) coefficient determines the degree of similarity between raters taking into account possibility of agreeing by chance
  - Kappa values <.00 = agreement is less than would occur purely by chance
  - .00 kappa = consensus rates are equal to chance,
  - Kappa up to .40 = slightly better than chance,
  - Kappa.41 to .60 = moderately better than chance,
  - Kappa >.60 = stronger than chance.

Calculating Cohen's Kappa for 2 raters

$$\kappa = \frac{P_o - P_c}{1 - P_c}$$

P_o (Probability of Observed) = $\frac{\text{Sum of agreement cells}}{N}$

P_c (Probability of chance) = $\frac{\text{Sum of Products of matching columns and rows}}{\text{N squared}}$

	Teachers			
Experts	Level 2	Level 3	Level 4	Total
Level 2	**14**	0	0	14
Level 3	2	**13**	0	15
Level 4	1	2	**2**	5
Total	17	15	2	34

N = 34; N^2=1156
P_o=(14+13+2)/34 = .85 [**NB**. This is exact consensus %; >70%=good]
P_c=(14*17)+(15*15)+(5*2)/1156 = (238+225+10)/1156 = .41
κ = (.85 - .41)/(1-.41) = .44/.59 = .746 ≈.75

If agreement is high, then systematic observation technique leads to robust result…..but are the results only a function of the coding?

Checking Drawings with Surveys: More triangulation

- A study with 3 techniques
  - *Feedback practices checklist*. Factor analysis of a list of 15 different practices that are ticked to indicate YES
  - *Fixed response survey--Student conceptions of feedback.* Factor analysis of 42 items
  - *Draw a picture of feedback.* Content analysis of student drawings

Harris, L. R., Brown, G. T. L., & Harnett, J. (2014). Understanding classroom feedback practices: A study of New Zealand student experiences, perceptions, and emotional responses. *Educational Assessment, Evaluation and Accountability, 26*(2), 107-133. doi: 10.1007/s11092-013-9187-5

Quantitative Results

- Conceptions of Feedback
  - 3 factors
    - Comments for Improvement (13 items),
    - Interpersonal Feedback (7 items), and
    - Negative Feedback (8 items)
  - fit good: $\chi^2 = 617.96$, $df = 347$, $\chi^2/df = 1.78$, p = .18; CFI = .87; gamma hat = .91; RMSEA = .064, 90% CI = 0.056-0.072, SRMR = .076
- Practices of Feedback
  - 3 factors
    - Teacher Evaluation (4 items),
    - Teacher Help (6 items), and
    - Interpersonal (4 items)
  - fit good: $\chi^2 = 133.38$, $df = 74$, $\chi^2/df = 1.80$, $p = .18$; CFI = .94; gamma hat = .96; RMSEA = .067, 90% CI = 0.048-0.085, SRMR = .069

Categories	Characteristics
Form of Feedback	
Teacher Feedback	• Written feedback from teacher • Spoken or nonverbal feedback from teacher
Student-led Feedback	• Spoken or non-verbal from self • Spoken or non-verbal feedback from peer • Written feedback from peer • Written feedback from self
Spoken Feedback	• Spoken or nonverbal feedback from teacher • Spoken or nonverbal feedback from self • Spoken or nonverbal feedback from peer • Feedback from parents
Written Feedback	• Written feedback from teacher • Written feedback from peer • Written feedback from self • Written feedback source ambiguous • Grades, results, scores, outcomes, reports • Ticks and crosses • Smiley face, stickers, stamps, rewards, certificates
Content of Feedback	
Task Feedback	• Describing or comparing performance • Suggestions for improvement, feed-forward • Surface learning features (spelling, grammar, basic facts, recall) • Presentation (neatness, layout, speed) • Deep learning (understanding, explaining, extending, clarifying)
Self Feedback	• Praise and encouragement • Effort and identifying improvement • Behaviour
Emotional Impact	
Positive	• Smiling student • Smiling teacher • Positive symbols
Negative	• Sad, angry, or upset student • Sad, angry or upset teacher • Negative symbols
Student Response to Feedback	
Accepts	• Student accepts feedback
Rejects	• Student rejects feedback
Shares	• Student shares feedback results with peers • Student shares feedback results with parents
Acts on	• Student action or intention to act on feedback from others • Student reflects, compares results, and/or proposes own action

Drawing Category Aggregation

Drawing content analysis quality check

Table 1. Inter-rater Reliability Statistics for Classifying Drawings by Four Major Categories

	Agreement statistic		
Category	Consensus	Pearson (*r*)	Kappa (κ)
Form of Feedback	97%	0.89	0.83
Content of Feedback	94%	0.82	0.85
Emotional Impact	96%	0.86	0.87
Student Response to Feedback	96%	0.86	0.88

Triangulating Methods

Table 11. Inter-Correlations of Drawing Traits to Feedback Practices and Conceptions

	Feedback Practices[a]			Conceptions of Feedback[b]		
Drawing Categories	Negative	Teacher Evaluation	Interpersonal	Teacher Help	Comments for Improvement	Interpersonal
Teacher Feedback	-0.08	-0.15*	-0.09	0.12	**0.21****	0.04
Student-led Feedback	**0.33****	**0.23****	-0.22**	-0.46**	-0.29**	-0.19**
Spoken Feedback	0.14	**0.19****	-0.02	-0.24**	-0.08	-0.02
Written Feedback	0.04	-0.07	-0.20**	-0.13	-0.14	-0.10
Task Feedback	**0.25****	0.06	-0.13	-0.07	-0.01	0.12
Self-Feedback	-0.14	-0.18*	-0.06	0.10	0.07	-0.09
Positive Affect	-0.23**	-0.19*	-0.20**	0.12	0.01	-0.10
Shares Feedback	-0.09	-0.17*	-0.17*	0.07	0.02	-0.02

Note. [a]*n*=182, [b]*n*=192 *$p<0.05$, **$p<0.01$

Look how many correlations = zero; the methods don't relate for lots of stuff.
Red=inverse; bold=positive

Looking across helps interpret the drawings….what do you see?

Concluding thoughts

- method effects result from instrument design, participant responses, and analytical processes and can cause data to say different things.
- Differences should be considered not so much as confirmatory or divergent, but rather as complementary
- Analyse data separately using methods suitable to each
- then compare results to see if any common messages resonate from both methods

To finish

- "triangulation attempts to confirm inferences made from the findings of several research methods and approaches. However, triangulation is less a method than a troublesome metaphor". (p. 465)
  - Smith, M. L. (2006). Multiple methodology in education research. In J. L. Green, G. Camilli, & P. B. Elmore (Eds.), *Handbook of complementary methods in education research (pp. 457-475). Mahwah, NJ: LEA.*

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