MANCHESTER 1824
The University of Manchester

Measuring Teaching Practices with the Rasch Model - Part 2: Instrument reduction and extensions

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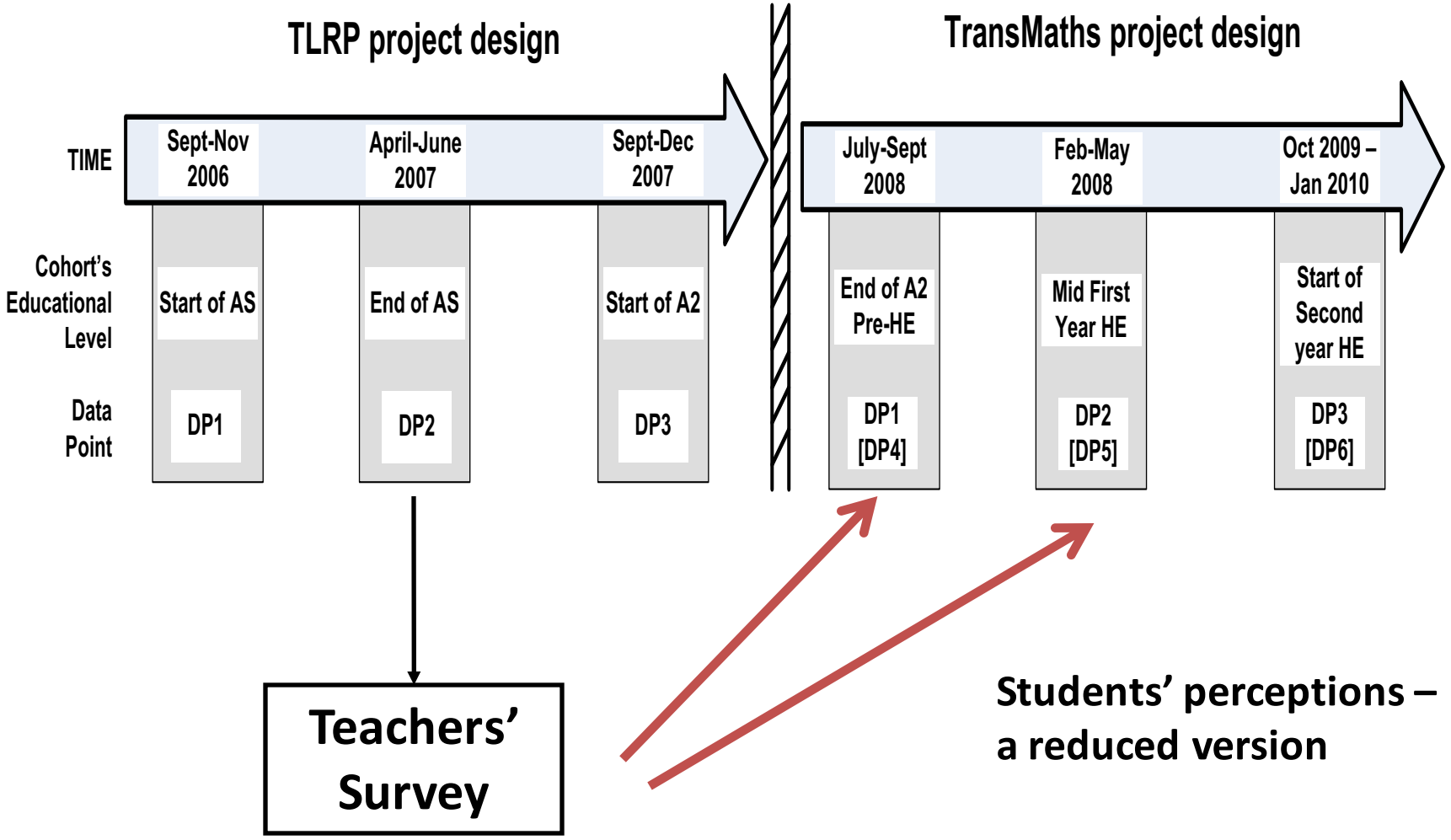
Outline

- A reduced version of a perception of Transmissionism teaching (from TLRP→Transmaths)
- Recent work with Core Maths programmes

- Validation results using Rasch Model
  - Cross-cohort analysis (3 studies for the common 11 items)
  - DIF results (based on study and maths course)
- Expanding the 'construct' with more items to capture 'contextual/real-life/professional' applications

- Some results with the use of such measures

Transmaths Work:
From Teacher Survey to a reduced version adopted and validated with students



Students' perception of pedagogy (Pre-university & University)

0. This is not relevant to me as I haven't learnt or studied mathematics this year. ☐					
	Almost never	Some of the time	Most of the time	Almost always	DON'T KNOW
1. We (students) use only the methods the lecturer teaches us.	☐	☐	☐	☐	
2. We choose which questions to tackle.	☐	☐	☐	☐	
3. We compare different methods for doing questions.	☐	☐	☐	☐	
4. The lecturer draws links between topics and moves back and forth between topics.	☐	☐	☐	☐	
5. We work collaboratively in small groups.	☐	☐	☐	☐	
6. We discuss our ideas.	☐	☐	☐	☐	
7. We work collaboratively in pairs.	☐	☐	☐	☐	
8. We invent our own methods.	☐	☐	☐	☐	
9. The lecturer tells us which questions to tackle.	☐	☐	☐	☐	
10. The lecturer encourages us to work more quickly.	☐	☐	☐	☐	
11. The lecturer teaches each topic separately.	☐	☐	☐	☐	

Some notes for the reduction of instrument story

- To get to this short version we first analysed the teacher's perceptions (TLRP work) and recalibrated with a smaller subset of items.
- Comparisons of teachers scores with the full and reduced version: highly correlated (almost the same)
- We recalibrated this version with the Transmaths students' sample (to recall pre-uni maths experience and experience with maths teaching at Uni)
- The instrument was also translated and recalibrated with a Norwegian sample

The context of new developments in: The Core Maths

- Core Maths is a pre-university alternative option for Maths (in comparison to traditional AS maths courses)
- Core Maths – espouses the concept of critical maths education
- Contextual Dimension – Real life constructs as an enabler in classroom mathematical dialogue
- Teacher and Student Dimensions – Using vocational experience as an example in classroom mathematical discuss.

The recent/new studies we refer to here:

- MEI evaluation of Critical Maths (one of Core Maths options, during 2014-2015, Led by J. Williams)
- PhD ongoing work of M. Omuvwie (Critical Mathematical Thinking Skills)

Instrument Development (MEI evaluation): Student Survey (five main parts)

- Part A: “About you and your class”
- Part B: “How maths is taught and learnt”
- Part C: “About your maths after this year”
- Part D: “Your feelings about mathematics”

1. Today’s date:		
2. Start-time to nearest minute:		
3. School name:		
4. Class name:		
5. Mathematics course name:		
6. Teacher name:		
7. My year group is: *(please circle one)*	Year 12	Year 13
8. I am: *(please circle one)*	Male	Female

PART B – HOW MATHS IS TAUGHT AND LEARNT

In this section we want to find out how maths is taught this year.

Please tell us, how often does the following happen in your maths lessons?

[Please circle the appropriate number in each line]		Almost Never	Rarely	Sometimes	Almost Always
1.	We (students) use only the methods the teacher teaches us.	1	2	3	4
2.	We choose which questions to tackle.	1	2	3	4
3.	We compare different methods for doing questions.	1	2	3	4
4.	The teacher draws links between topics and moves back and forth between topics.	1	2	3	4
5.	We work collaboratively in small groups (of 3 to 6).	1	2	3	4
6.	We discuss our ideas.	1	2	3	4
7.	We work collaboratively in pairs.	1	2	3	4
8.	We invent our own methods.	1	2	3	4
9.	The teacher tells us which questions to tackle.	1	2	3	4
10.	The teacher encourages us to work more quickly.	1	2	3	4
11.	We explain our work to the whole class.	1	2	3	4

Data: from three studies

- 1778 Transmaths students (retrospective responses at the start of Uni to report teaching practices in Mathematics before) – 2008-2009
- MEI evaluation study – June (to copy from last year) – 140 Core Maths
- Critical Mathematical Thinking Skills (CMTS) Study – so far: 119 Core Maths, 74 AS (Traditional)

Measurement Approach

- Rasch Analysis (IRT) and in particular: Rasch Rating Scale Model
- 'Winsteps software
- Interpreting Results:
  - Item Fit Statistics (to ensure unidimensional measures)
  - Differential Item Functioning for 'subject' groups
  - Person-Item maps for hierarchy
  - Qualitative checks

Validation results with the Use of Rasch Model

- Cross -cohort analysis (3 studies for the common 11 items)
- Compare calibrations based on study and maths course (DIF)

- Expanding the ‘construct’ with more items to capture ‘contextual/real-life/professional’ applications

Recoding Items:

Higher scores to indicate more 'Transmissionism'

PART B – HOW IS MATHS TAUGHT AND LEARNT

In this section, we want to find out how you are taught maths in general. Please tell us how often does each of the following happen in your normal weekly maths lessons?

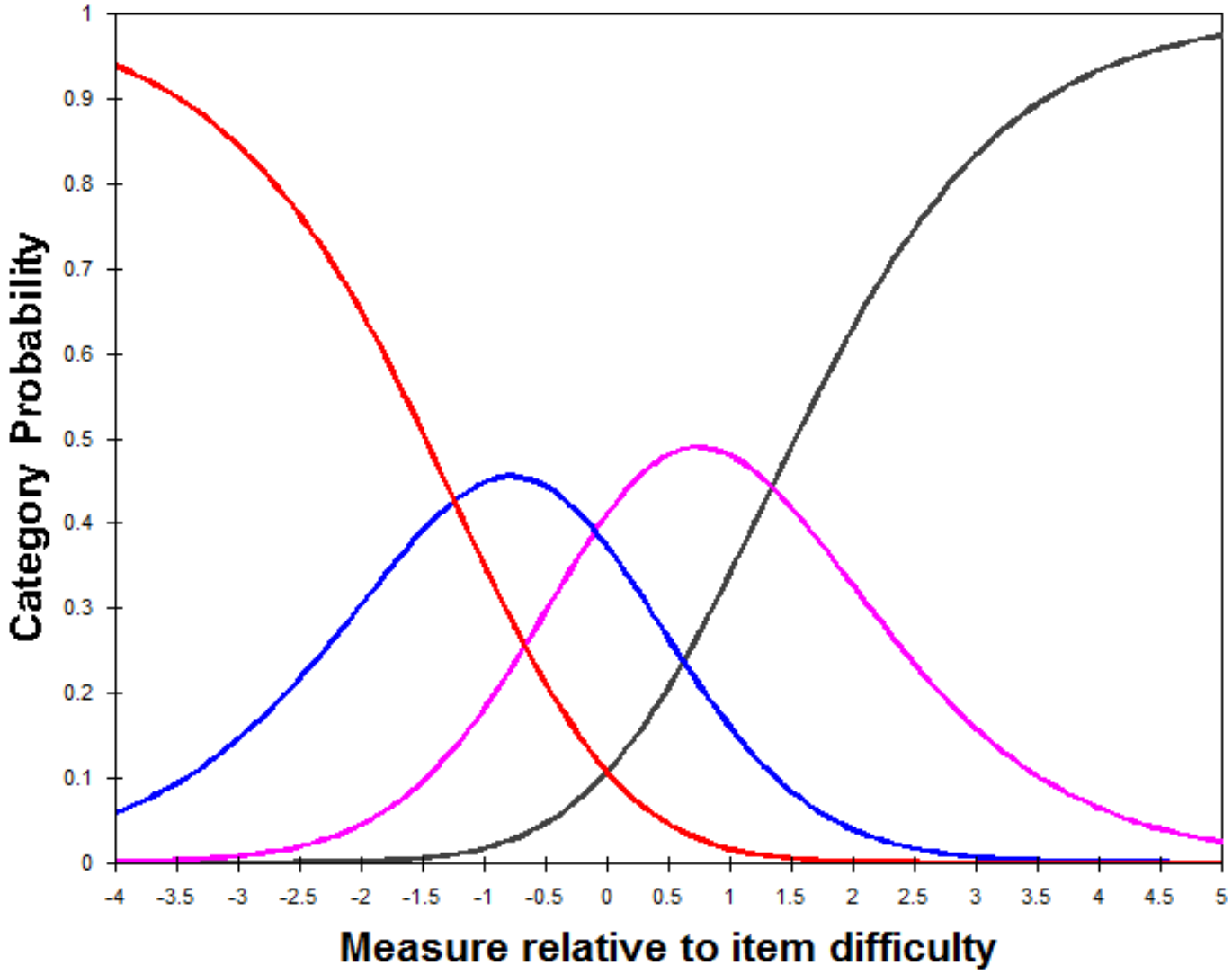
[Please circle the appropriate number for each line]		Almost Never	Some of the time	Most of the time	Almost Always
1.	We (students) use only the methods the teacher taught us.	1	2	3	4
2.	We choose which questions to tackle.	1	2	3	4
3.	We compare different methods for doing questions.	1	2	3	4
4.	The teacher draws links between different topics.	1	2	3	4
5.	We work collaboratively in small groups.	1	2	3	4
6.	We discuss our own ideas.	1	2	3	4
7.	We work collaboratively in pairs.	1	2	3	4
8.	We invent our own methods.	1	2	3	4
9.	The teacher tells us which questions to tackle.	1	2	3	4
10.	The teacher encourages us to work more quickly.	1	2	3	4
11.	The teacher teaches each topic separately.	1	2	3	4

4 3 2 1

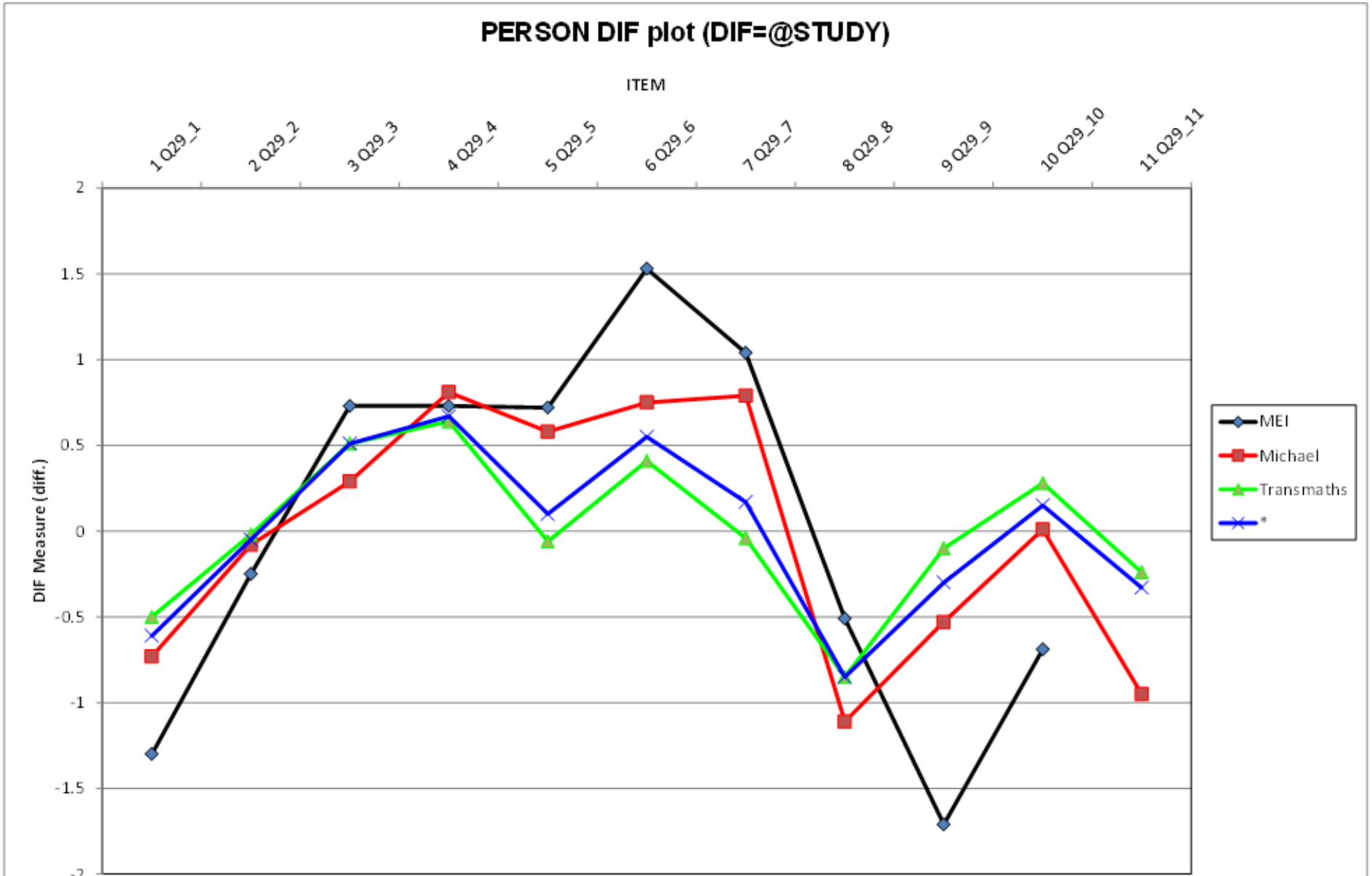
Fit Statistics (Pooled): To check for unidimensionality

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
1	5525	1796	-.61	.03	.86	-4.8	.90	-3.2	.40	.46	55.9	49.2	Q29_1
2	4909	1778	-.05	.03	.87	-4.4	.88	-4.0	.50	.49	51.6	46.0	Q29_2
3	4296	1781	.51	.03	.80	-7.5	.80	-7.2	.59	.51	50.2	44.7	Q29_3
4	4101	1771	.67	.03	.90	-3.4	.92	-2.9	.55	.52	49.1	44.8	Q29_4
5	4758	1783	.10	.03	.97	-.9	.96	-1.3	.62	.50	46.7	45.8	Q29_5
6	4265	1783	.55	.03	.87	-4.6	.87	-4.7	.66	.52	46.6	44.8	Q29_6
7	4684	1783	.17	.03	1.05	1.7	1.06	2.1	.50	.50	44.2	45.7	Q29_7
8	5688	1776	-.85	.03	1.06	1.9	1.01	.4	.55	.44	51.8	51.1	Q29_8
9	5177	1781	-.30	.03	1.07	2.3	1.06	1.9	.41	.48	49.2	47.6	Q29_9
10	4700	1781	.15	.03	1.43	9.9	1.49	9.9	.21	.50	37.7	45.7	Q29_10
11	4695	1591	-.33	.03	1.13	3.9	1.14	4.0	.39	.47	45.0	47.9	Q29_11
MEAN	4799.8	1764.0	.00	.03	1.00	-.5	1.01	-.5			48.0	46.7	
S.D.	479.9	55.0	.46	.00	.17	4.8	.18	4.6			4.6	2.0	

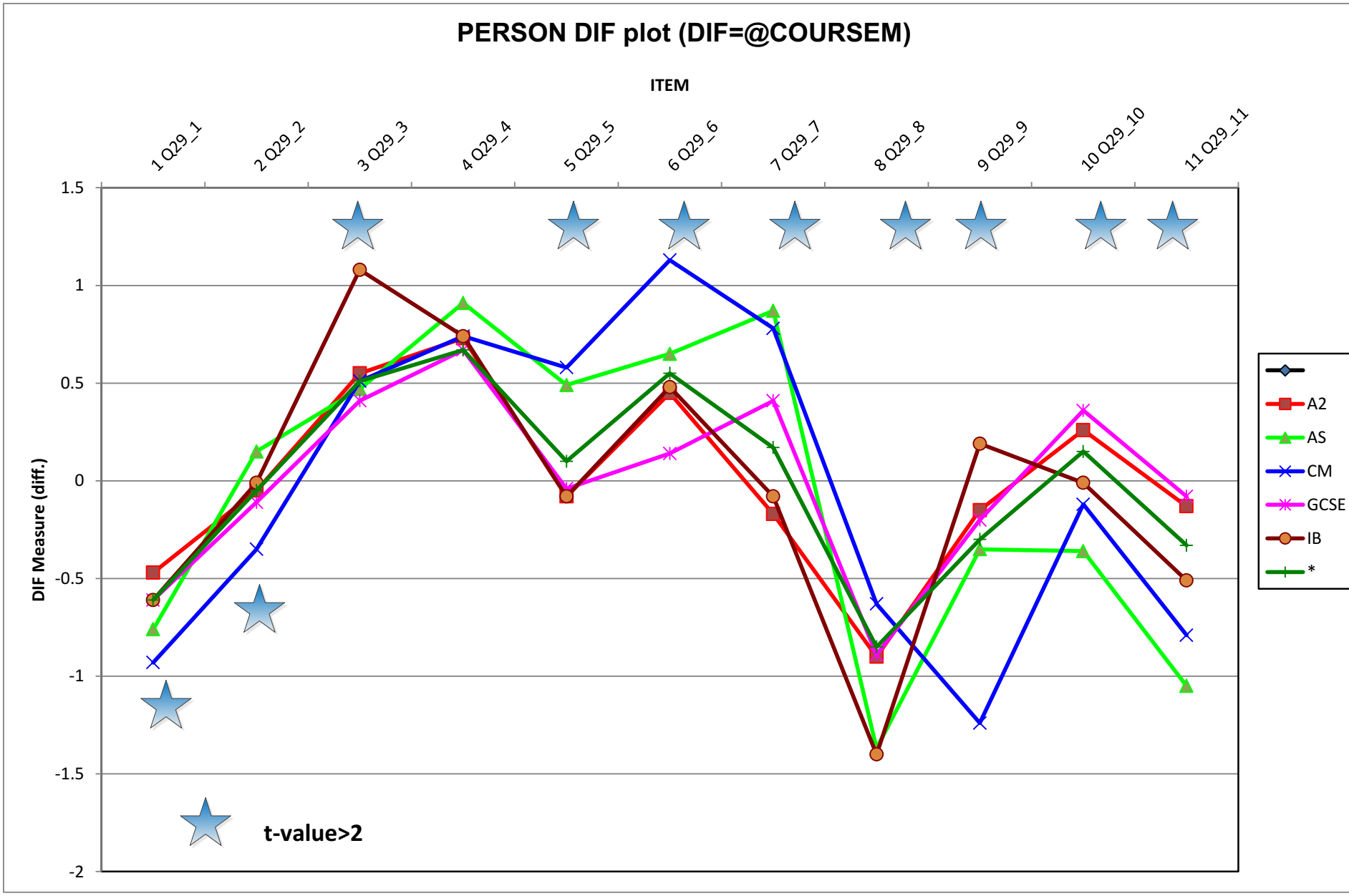
Category Statistics (for the rating scale)



But…DIF between studies…



Maybe due to different courses or time points??



Focus on CMTS study

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
1	662	213	-.80	.10	.81	-2.1	.84	-1.8	.30	.40	60.6	52.0	Q29_1
2	578	212	-.07	.09	.89	-1.3	.91	-1.0	.40	.43	48.6	48.8	Q29_2
3	530	213	.34	.09	.79	-2.6	.79	-2.5	.55	.44	51.2	46.3	Q29_3
4	459	213	.91	.09	.69	-4.2	.68	-4.2	.50	.45	54.9	45.6	Q29_4
5	490	213	.66	.09	.90	-1.2	.90	-1.2	.66	.45	43.2	45.6	Q29_5
6	467	213	.85	.09	.92	-1.0	.93	-.8	.55	.45	47.9	45.6	Q29_6
7	462	213	.89	.09	1.10	1.2	1.10	1.1	.53	.45	44.1	45.6	Q29_7
8	702	213	-1.21	.11	1.23	2.3	1.14	1.4	.55	.37	49.3	52.4	Q29_8
9	638	213	-.57	.10	1.03	.4	1.03	.3	.26	.41	55.9	51.6	Q29_9
10	568	213	.03	.09	1.62	5.9	1.67	6.3	.02	.44	34.7	48.1	Q29_10
11	686	213	-1.04	.10	1.07	.7	1.08	.9	.33	.39	47.9	51.9	Q29_11
MEAN	567.5	212.9	.00	.09	1.00	-.2	1.01	-.1			48.9	48.5	
S.D.	88.7	.3	.76	.01	.24	2.6	.25	2.6			6.6	2.8	

Some new items

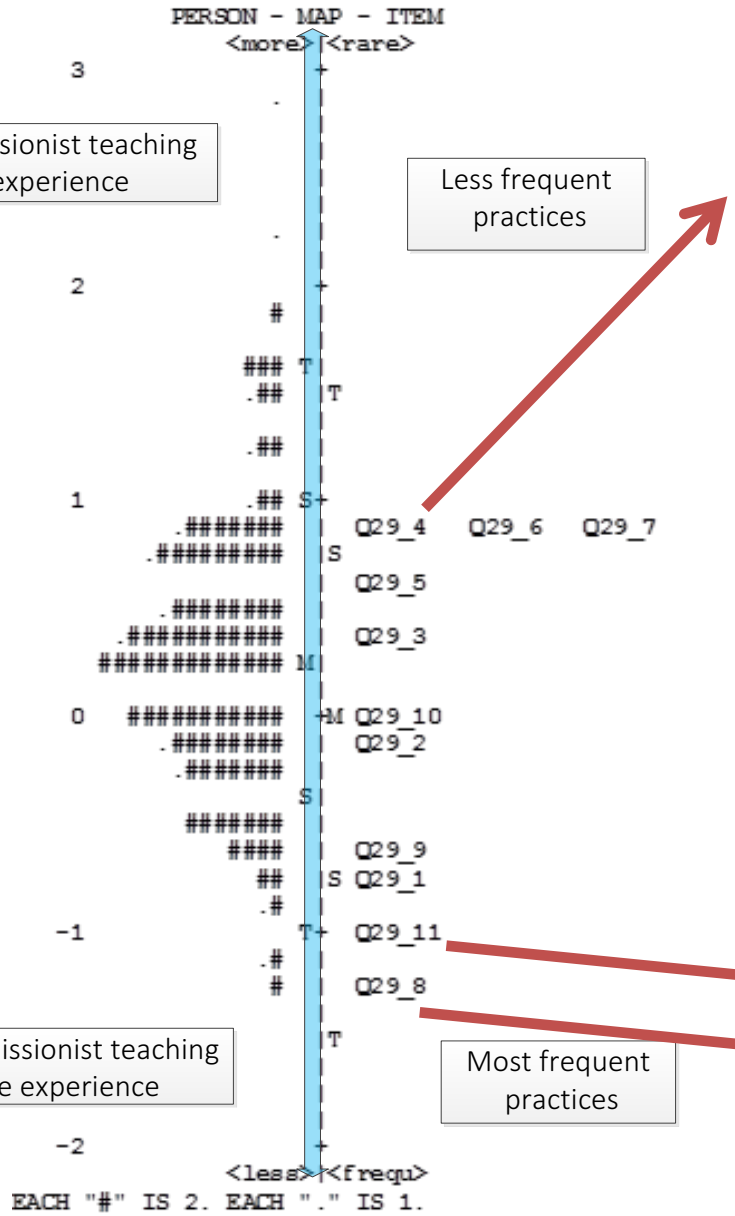
12.	What we learn is related to everyday real life situations.	1	2	3	4
13.	We use resources from the internet.	1	2	3	4
14.	We explain our work to the whole class.	1	2	3	4
15.	The teacher uses own work experiences in classroom discussions.	1	2	3	4
16.	We use our own background experiences in the classroom.	1	2	3	4
17.	The teacher questions our methods.	1	2	3	4

- Some used in different versions before (e.g. 14) or in a similar way (e.g. 13 in Teleprism)
- To capture context relevant to Critical maths (and core maths classes)
- All but 17 initially reversed
- But was shown with negative point bi-serial correlation so its was also reversed

Fit statistics

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
1	662	213	-.68	.10	.88	-1.3	.89	-1.2	.22	.42	56.3	50.0	Q29_1
2	578	212	.03	.09	.95	-.6	.97	-.4	.33	.45	49.5	48.3	Q29_2
3	530	213	.43	.09	.81	-2.3	.82	-2.3	.51	.45	53.1	46.0	Q29_3
4	459	213	.98	.09	.68	-4.2	.68	-4.2	.48	.44	56.3	45.0	Q29_4
5	490	213	.74	.09	.94	-.7	.93	-.8	.60	.45	43.2	44.7	Q29_5
6	467	213	.92	.09	.87	-1.6	.87	-1.5	.56	.44	51.2	44.9	Q29_6
7	462	213	.96	.09	1.15	1.7	1.14	1.6	.47	.44	41.3	45.0	Q29_7
8	702	213	-1.08	.10	1.05	.6	.98	-.2	.67	.40	54.5	52.0	Q29_8
9	638	213	-.46	.09	1.15	1.6	1.14	1.5	.13	.43	51.6	49.9	Q29_9
10	568	213	.13	.09	1.77	7.2	1.83	7.6	-.13	.45	31.5	47.7	Q29_10
11	686	213	-.92	.10	1.08	.9	1.12	1.3	.30	.41	46.5	51.1	Q29_11
12	584	213	.00	.09	1.02	.2	1.04	.4	.46	.45	46.9	48.3	TM12
13	607	213	-.19	.09	1.22	2.3	1.27	2.8	.35	.44	49.3	49.1	TM13
14	596	213	-.10	.09	.90	-1.1	.91	-1.0	.57	.44	46.0	48.7	TM14
15	640	211	-.53	.10	.79	-2.4	.79	-2.4	.61	.43	50.2	49.8	TM15
16	648	212	-.58	.10	.88	-1.3	.85	-1.6	.73	.43	47.2	50.2	TM16
17	535	211	.35	.09	.86	-1.7	.87	-1.5	.53	.45	49.8	46.4	TM17
MEAN	579.5	212.6	.00	.09	1.00	-.2	1.01	-.1			48.5	48.1	
S.D.	76.5	.7	.64	.00	.24	2.5	.25	2.6			5.9	2.3	

The person-item map (initial)



More transmissionist teaching practice experience

Less frequent practices

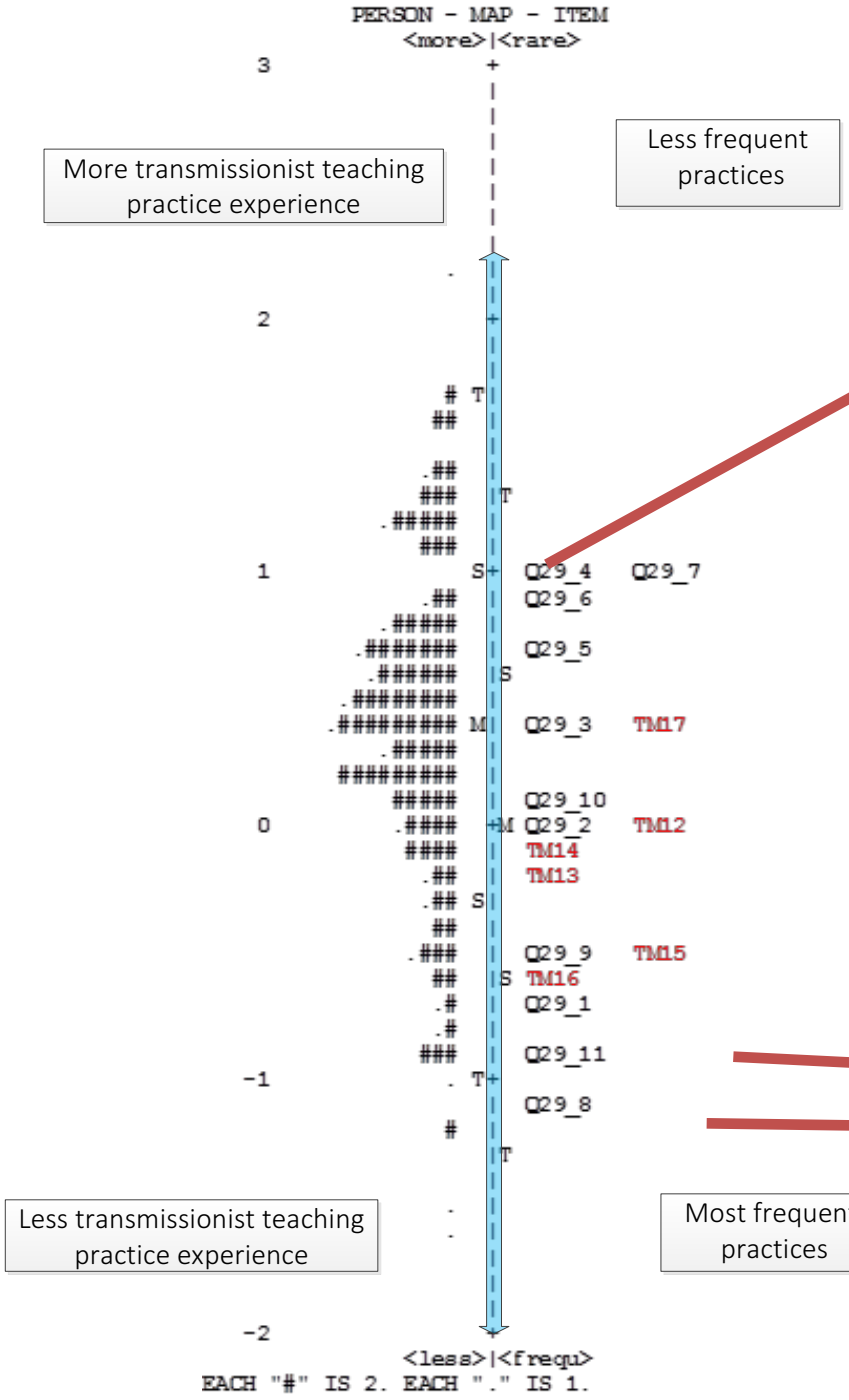
4 (R): The teacher (doesn't) draw links between different topics

11: The teacher teaches each topi separately

8 (R): We (don't) invent our own methods

Most frequent practices

Less transmissionist teaching practice experience



More transmissionist teaching practice experience

Less frequent practices

Less transmissionist teaching practice experience

Most frequent practices

Extended version

4 (R): The teacher (doesn't) draw links between different topics

17 (R): The teacher (doesn't) question our methods

12(R): What we learn is (not) related to everyday…
14 (R): we (don't) explain our work to the whole class
13(R): We (don't) use resources from the internet

15(R): The teacher (doesn't) use own experience…
16(R): We (don't) use our own background experiences in the classroom

11: The teacher teaches each topic separately

8 (R): We (don't) invent our own methods

How such measure has been used before (MEI study): Correlations between measures

Correlations

		TransmissionistTeach	Competence	MathsIdentity	MathsDisposition
TransmissionistTeach	Pearson Correlation	1	.029	-.216**	-.147
	Sig. (2-tailed)		.718	.004	.055
	N	176	162	172	171
Competence	Pearson Correlation	.029	1	.162*	.119
	Sig. (2-tailed)	.718		.039	.131
	N	162	163	163	162
MathsIdentity	Pearson Correlation	-.216**	.162*	1	.595**
	Sig. (2-tailed)	.004	.039		.000
	N	172	163	173	172
MathsDisposition	Pearson Correlation	-.147	.119	.595**	1
	Sig. (2-tailed)	.055	.131	.000	
	N	171	162	172	172

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Some concluding thoughts

- These are preliminary findings from a new study
- Extension of the scale still remains to be validated with qualitative data
- Also to check whether the ‘teacher background’ item might be a ‘Group’ indicator (e.g. check for DIF) rather than an item?
- …