



**Kingston
University**
London

**Mathematics Education
Research Special Interest Group**

Exploring Mathematics Anxiety and Attitude among Student Teachers in the First Year of their Initial Teacher Training

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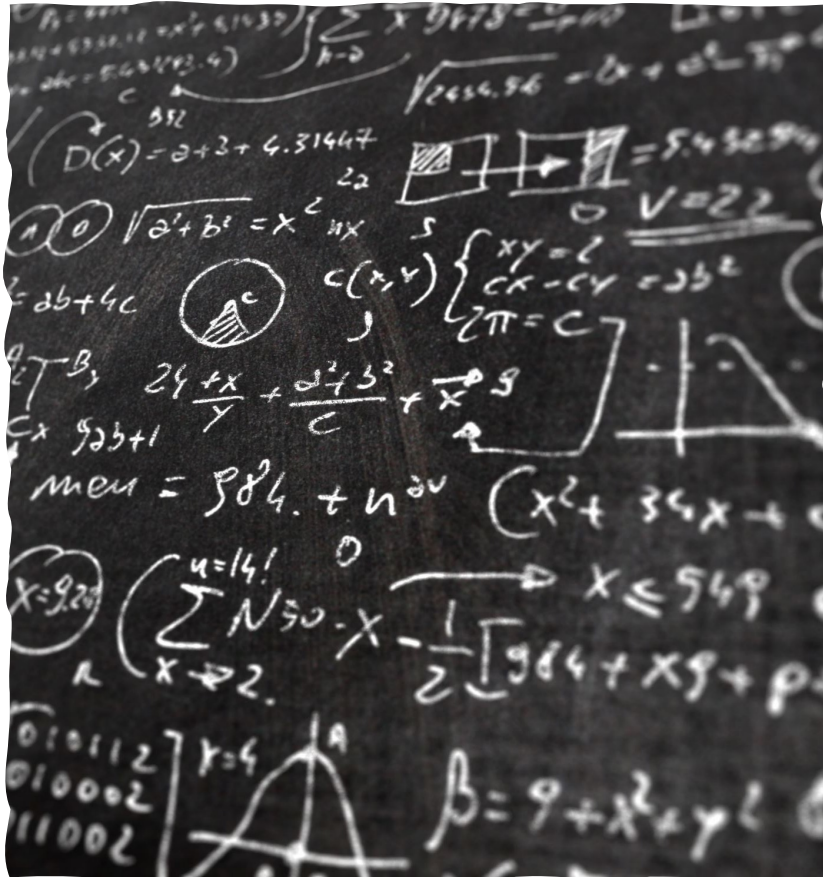
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Background



Initial Teaching Training Tutors in our University observed elements of anxiety and negativity towards mathematics among trainee teachers;

- a reluctance to actively participate in mathematics-related sessions
- concerns about their ability to teach mathematics,
- avoid mathematics when they were asked to choose a subject specialism.

What do we know from previous research

Mathematics anxiety is associated with low performance and achievement, and an unfavourable attitude towards mathematics

(Ashcraft & Krause, 2007; Espino et al., 2017)

Unfavourable attitude towards mathematics impacts performance and achievement, career and course-related decisions

(Espino et al., 2017)

For student teachers, high maths anxiety and poor attitude are linked with avoidance tactics regarding teaching mathematics and reduced time commitment in planning lessons

(Swetman et al., 1993)

Mathematically anxious teachers tend to have poor attitudes and perpetuate their anxiety and negative attitudes towards mathematics among their students

(McAnallen, 2010)

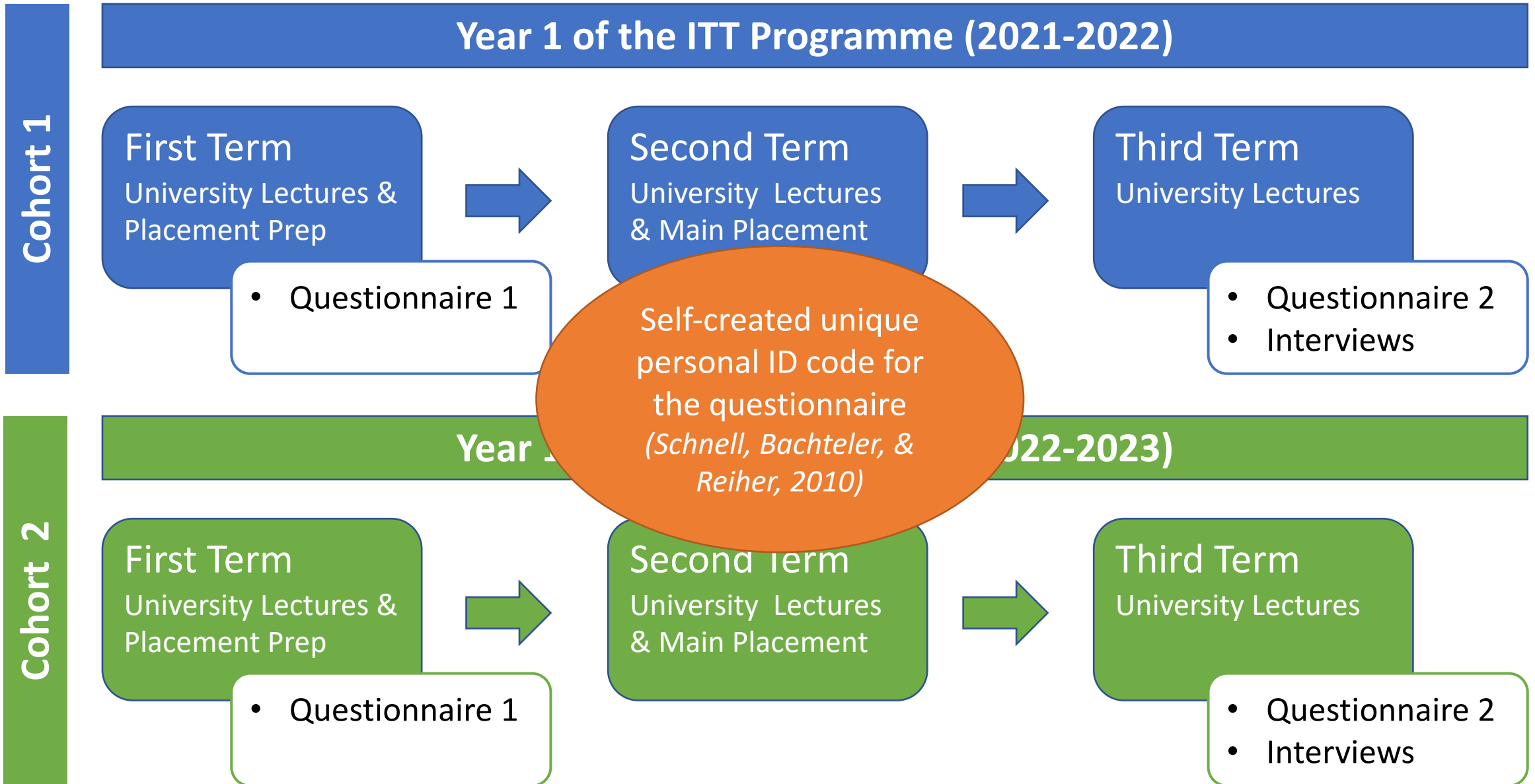
Relationships and impact directions are complex and not easy to determine. Some are clearer (e.g. anxiety and performance), some not (e.g. attitude to teaching maths)

(Ernest, 1988)

Research Objectives

- To find out at the start and the end of the first-year ITT course and then compare, the student teachers',
 - levels of mathematics anxiety,
 - attitudes towards mathematics,
 - attitudes towards teaching mathematics,
 - experiences from formal mathematics instruction before and during the first-year ITT course, and
 - Intentions regarding choosing mathematics as a subject specialism.
- Identify relationships between all the above and other factors (e.g. qualification, age, gender and ethnicity).

Research Design



Participants

	'21-'22 Cohort	'22-'23 Cohort	Totals
All Students	43	40	83
Responses/Participation	N (Rate)	N (Rate)	N (Rate)
Questionnaire 1	20 (47%)	15 (38%)	35 (42%)
Questionnaire 2	14 (33%)	25 (63%)	39 (47%)
Both Questionnaires (1 & 2)	12 (28%)	12 (30%)	24 (29%)
1:1 Semi-structured interviews	3 (7%)	3 (8%)	6 (7%)

Participant's Profiles

Questionnaire 1	Cohort '21-'22 (n=20)	Cohort '22-'23 (n=15)
Age group – prefer not to say	0 (0%)	1 (6.7%)
Younger than 20 years old	7 (35%)	8 (53.3%)
20-25	8 (40%)	3 (20%)
26-30	2 (10%)	1 (6.7%)
Older than 30	3 (15%)	2 (13.3%)
Gender - Female	17 (85%)	15 (100%)
English as main language	17 (85%)	14 (93.3%)
Qualification Higher than GCSE (e.g. A Level)	2 (10%)	2 (13.3%)
Country undertaking Sec Ed - UK	18 (90%)	13 (86.7%)
Ethnicity - White British	13 (65%)	5 (33.3%)

The Questionnaire

Topics explored and type of questions	Questionnaires
Mathematics anxiety Abbreviated Math Anxiety Scale (AMAS) (Hopko Et Al., 2003) 9-item Likert-type scale 1-5, low to high	Questionnaire 1 & 2
Attitudes towards mathematics Short Attitudes Toward Mathematics Inventory (sATMI) (Lim & Chapman, 2013) 19-item Likert-type scale 1-5, from strongly disagree to strongly agree	Questionnaire 1 & 2
Attitudes towards teaching mathematics Mathematics Teaching Attitude Questionnaire (MTAQ) (Nisbet, 1991) 14-(out of 22)-item Likert-type scale 1-5 (changed from 1-7), from strongly disagree to strongly agree	Questionnaire 1 & 2
Experience from formal mathematics instruction (before ITT) and choice of specialism 4- & 1-item Likert-type scales 1-5, from strongly disagree to strongly agree	Questionnaire 1
Experience from formal mathematics instruction (during ITT) and choice of specialism 2- & 1-item Likert-type scale 1-5, from strongly disagree to strongly agree	Questionnaire 2
Background information (e.g., gender, age, qualification, ethnic group)	Questionnaire 1
Invitation to a follow-up interview	Questionnaire 2

Analysis

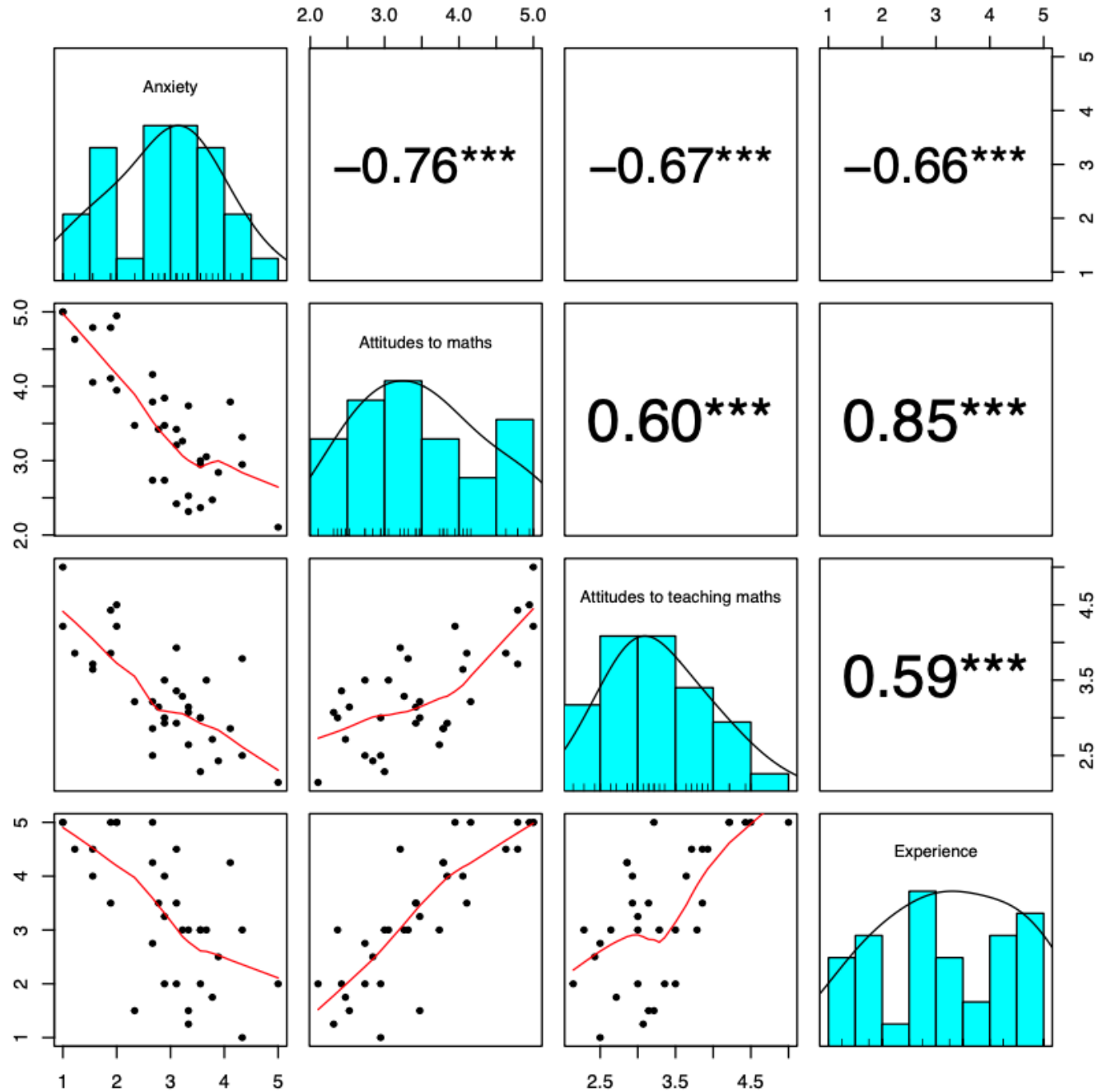
- Descriptive statistics, averages and standard deviations, to identify patterns
- Inferential statistics using correlation and regression analysis models to compare the data from all metrics:
 - scatter plots and Spearman's correlation coefficients to explore correlations,
 - the Poisson pseudo-maximum likelihood regression model and exponentiated coefficients to explore impact relationships
 - an ordered logit model to examine how the four metrics and personal characteristics affect people's choice of subject specialism
- Open questions and interviews were analysed thematically.



Averages from the key metrics from all responses, all questionnaires

	Maths anxiety	Attitudes to maths	Attitudes to teaching maths	Experience
<i>'21-'22 Cohort - Mean (SD)</i>				
Start (Q1, n=20)	2.93 (1.00)	3.39 (0.83)	3.20 (0.60)	3.08 (1.28)
End (Q2, n=14)	2.83 (1.01) ↓	3.63 (0.87) ↑	3.45 (0.78) ↑	3.61 (1.16) ↑
<i>'22-'23 Cohort - Mean (SD)</i>				
Start (Q1, n=15)	3.25 (1.18)	2.71 (1.08)	2.96 (0.71)	2.32 (1.41)
End (Q2, n=25)	2.60 (1.02) ↓	2.74 (0.73) ↑	2.80 (0.68) ↓	3.22 (0.82) ↑

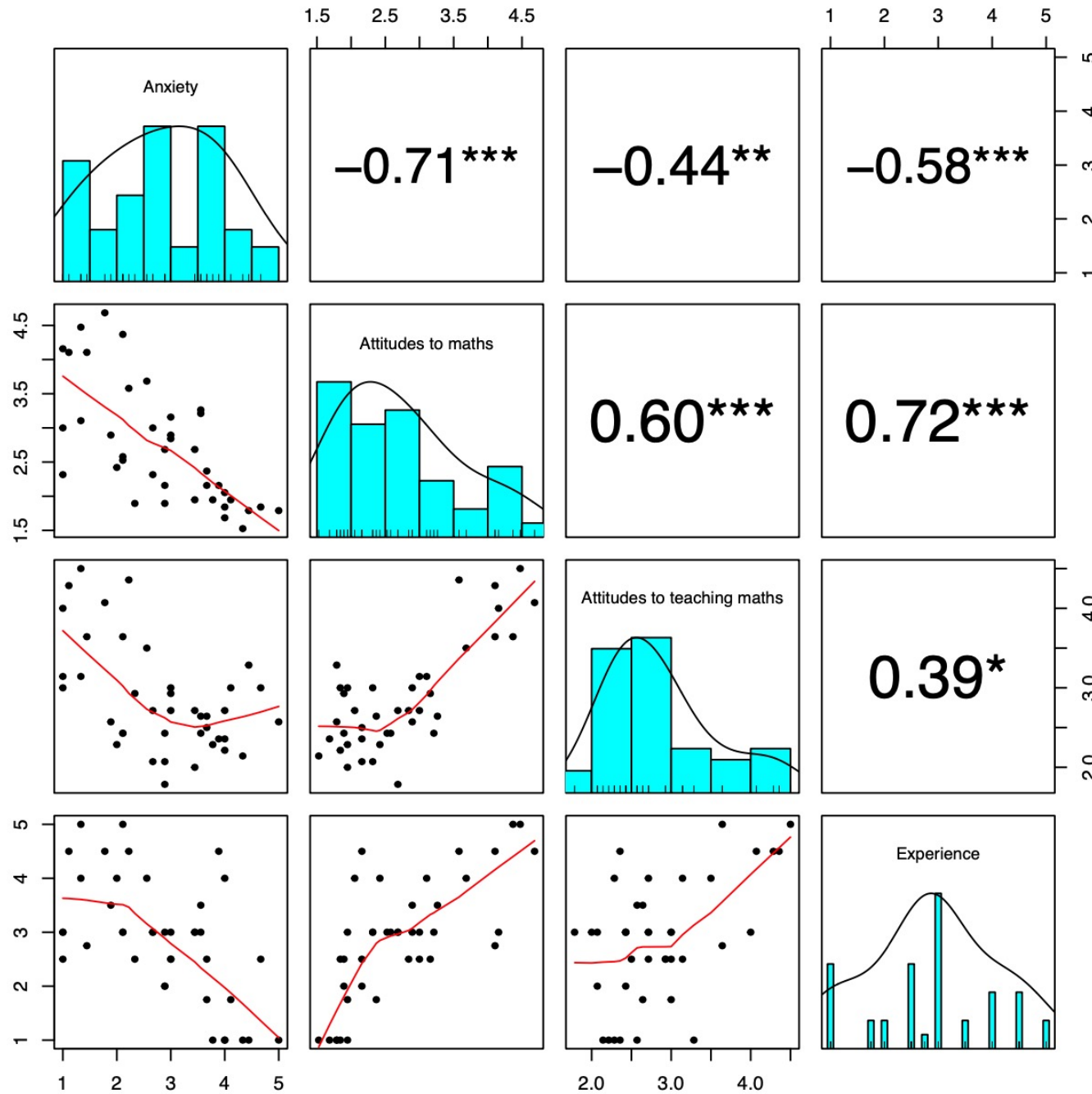
Scatter plots and Spearman's correlation coefficients: '21-'22 cohort



Q1 ($n=20$)
Q2 ($n=14$)

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Scatter plots and Spearman's correlation coefficients: '22-23 cohort



Q1 ($n=15$)
Q2 ($n=25$)

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Poisson pseudo-maximum likelihood regression coefficients: Random Effects analysis (i)

Students who completed both questionnaires only

N = 12 in each cohort x 4 Qs = 48 observations	Maths anxiety	Attitudes to maths	Attitudes to teaching maths	Experience from formal maths instructions
Maths anxiety		0.972 [0.905,1.044]	0.979 [0.925,1.036]	0.909 [0.793,1.043]
Attitudes to maths	0.908 [0.722,1.142]		1.201^{***} [1.106,1.305]	1.076 [0.774,1.497]
Attitudes to teaching maths	0.914 [0.753,1.110]	1.137^{**} [1.040,1.243]		0.926 [0.584,1.468]
Experience from formal maths instructions	0.987 [0.926,1.051]	1.001 [0.975,1.028]	1.005 [0.954,1.058]	

*Exponentiated coefficients; 95% confidence intervals in brackets | * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

Poisson pseudo-maximum likelihood regression coefficients: Random Effects analysis (ii)

Students who completed both questionnaires only

N = 12 in each cohort x 4 Qs = 48 observations	Maths anxiety	Attitudes to maths	Attitudes to teaching maths	Experience from formal maths instructions
Training in the first year of the ITT course	0.928 [0.823,1.047]	1.009 [0.951,1.069]	1.002 [0.956,1.050]	1.283** [1.092,1.506]
English as the main language	1.345** [1.121,1.614]	0.875* [0.781,0.980]	1.137** [1.041,1.241]	1.093 [0.884,1.353]
UK Secondary Education	0.926 [0.717,1.195]	0.969 [0.862,1.089]	1.017 [0.916,1.129]	1.015 [0.844,1.220]
Grade	1.047 [0.965,1.137]	1.011 [0.959,1.065]	0.988 [0.938,1.041]	1.037 [0.982,1.096]
GCSE	1.111 [0.723,1.708]	1.204 [0.920,1.575]	0.863 [0.683,1.091]	1.092 [0.830,1.439]

Exponentiated coefficients; 95% confidence intervals in brackets | * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Poisson pseudo-maximum likelihood regression coefficients: Random Effects analysis (iii)

Students who completed both questionnaires only

N = 12 in each cohort x 4 Qs = 48 observations	Maths anxiety	Attitudes to maths	Attitudes to teaching maths	Experience from formal maths instructions
Age 20-25	1.148 [0.911,1.447]	0.907 [0.802,1.026]	1.156 *** [1.079,1.238]	1.071 [0.919,1.248]
Age 26-30	0.883 [0.690,1.130]	1.089 [0.955,1.240]	0.845 *** [0.770,0.928]	0.926 [0.770,1.114]
Age >30	1.115 [0.833,1.493]	0.869 [0.714,1.058]	1.155** [1.037,1.287]	0.962 [0.716,1.293]
Female	1.167 [0.855,1.591]	0.766*** [0.655,0.895]	1.327*** [1.196,1.471]	1.243 [0.935,1.652]
White	1.235 [0.873,1.748]	0.857 [0.724,1.015]	1.217*** [1.105,1.342]	1.100 [0.910,1.330]

Age ref point: <20 | Exponentiated coef.; 95% confidence intervals in brackets | * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Ordered logit regression coefficients (choice) (i)

Students who completed both questionnaires only

N = 12 in each cohort x 4 Qs = 48 observations

	Choosing maths for specialism	Confidence intervals (95%)
Maths anxiety	-0.126	[-2.008,1.756]
Attitudes to maths	4.043	[-0.233,8.319]
Attitudes to teaching maths	1.222	[-5.398,7.842]
Experience from formal maths instructions	1.184	[-1.219,3.588]
Training in the first year of the ITT course	0.562	[-1.433,2.557]
English as the main language	-6.496*	[-11.575,-1.416]
UK Secondary Education	7.002*	[1.424,12.580]

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Ordered logit regression coefficients (choice) (ii)

Students who completed both questionnaires only

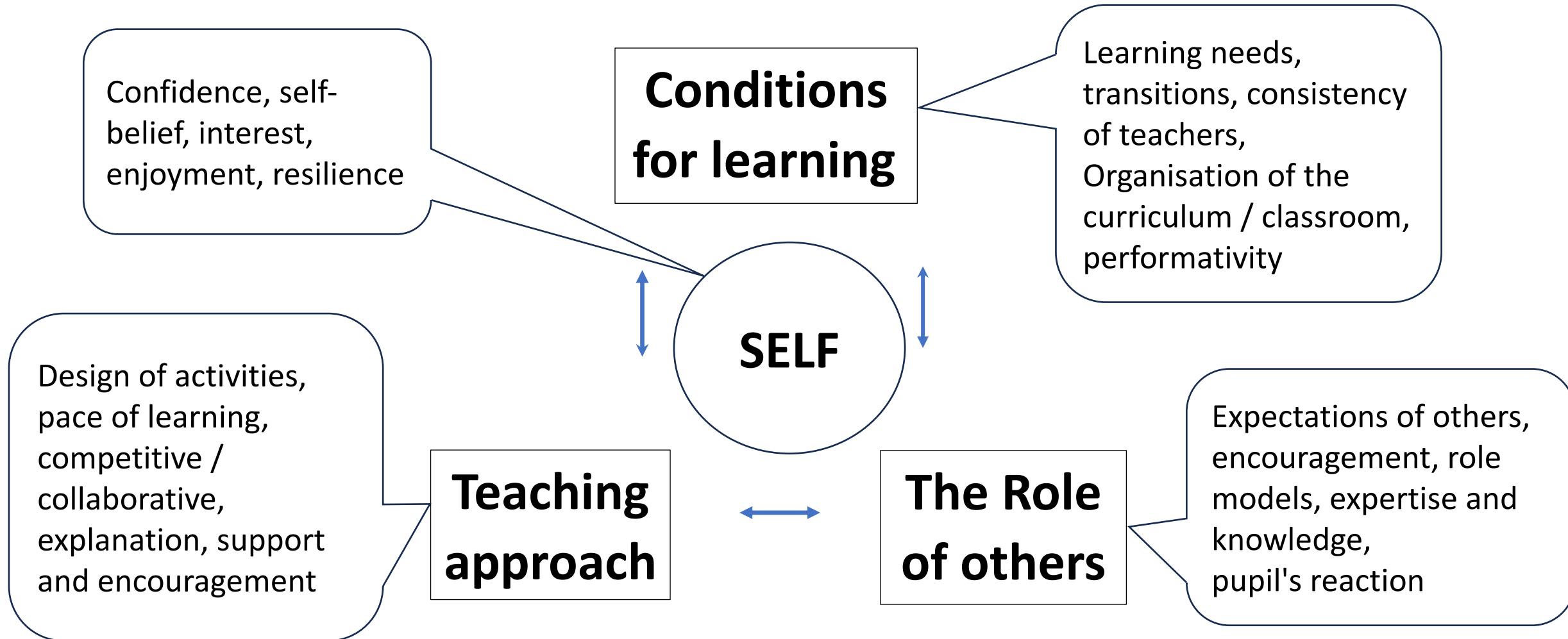
N = 12 in each cohort x 4 Qs = 48 observations

	Choosing maths for specialism	Confidence intervals (95%)
GCSE	2.497	[-2.784,7.778]
Grade	1.280**	[0.479,2.082]
Age 20-25	-3.054**	[-5.375,-0.733]
Age 26-30	-1.036	[-2.744,0.672]
Age >30	-8.153***	[-11.401,-4.905]
Female	1.700	[-1.689,5.089]
White	-3.984***	[-6.226,-1.741]

Age ref point: <20

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Response categories (Interviews and questionnaires)



Example from open questions

Reasons for liking/enjoying (or not) mathematics at school

*During primary school I was constantly monitored while doing math and it **made me feel like I was dumb**. There was also a rhetoric that you had to naturally be good at maths by my peers. It felt like **both teachers and my peers only cared about who was fast with their mental maths** [...] I, therefore, felt like a lost cause in math.*

*During my time at secondary school I **changed maths teachers more than 6 times some lasting less than 2 months**. Not only did I dislike majority of my teachers, they all had drastically **different teaching styles** and I learnt an overwhelming amount of ways to work out an answer. Working to solve answers was taught very in a very **formulaic way**. This made me think **memory was the key to math** and I received NO emphasis on depth until it was deemed “too late” and a “waste of time” by my teachers.*

*Additionally, majority of my classes were **90% behaviour management**. [...] There was **rarely any praise** of the work I had done.*

(Female student teacher from '22-'23 Cohort, Questionnaire 1)

Example from open questions

Reasons for choosing/not choosing mathematics specialism

Love and passion for the subject – help the pupils feel the same:

“ I have always enjoyed maths at school and still do now, I think it is important for a teacher to be passionate about the subject they are teaching as this will come across in the lesson and make the children mirror this same passion” (Female student teacher from '21-'22 Cohort, Questionnaire 2)

Lack of confidence and enjoyment:

“ It is the subject I [have] least confidence in.” (Female student teacher from '22-'23 Cohort, Questionnaire 2)

“I in no way feel that I could complete a specialism in maths! The enjoyment is just not there.” (Female student teacher from '22-'23 Cohort, Questionnaire 1)

Concluding remarks

- Correlations between mathematics anxiety, attitudes to maths, attitudes to teaching maths and experiences from formal instructions
- Some positive impact of the ITT course on the maths specialism choice, anxiety and attitudes to maths and teaching maths but not significant
- Statistically significant correlations between,
 - attitudes to maths & attitudes to teaching maths
 - positive experiences from formal maths instructions & the ITT course
 - gender & attitudes to maths
 - gender, age, ethnicity & attitudes to teaching maths
 - English as the main or second language & all three: maths anxiety, attitudes to maths and attitudes to teaching maths
 - language, grade, age, ethnicity, country of secondary education & mathematics specialism choice

Implications for ITT providers

- Initial Teacher Training can provide better experiences in mathematics learning, and thus impact mathematical attitude, mainly because of the emphasis on understanding mathematical concepts and how to explain mathematics when teaching
- Attitudes to maths and attitudes to teaching mathematics may relate differently to different factors (e.g. age, gender, first language), but a change in mathematical attitude will significantly impact a change in attitude towards teaching mathematics and vice versa
- We need to pay more attention to groups which tend to be a majority in ITT courses for primary education and which are associated with low attitudes to mathematics (e.g. female students and students with English as the main language) and high maths anxiety (e.g. students with English as the main language)
- The choice of maths as a specialism does not associate with mathematical anxiety and attitude (to the subject or the teaching of the subject) but rather with environmental factors, including ethnicity, spoken language, education experience and accumulated experience through age (being a younger or older student)

The background of the slide features a close-up, high-angle shot of a silver pen writing on a white document. The pen is positioned in the upper right corner, and a dark, jagged line graph is visible on the page. The lighting is soft, creating a professional and focused atmosphere. A large white circular shape overlaps the left side of the image, serving as a backdrop for the text.

Next Step

-
- New larger-scale research, including more ITT providers and student teachers
 - A longitudinal study to collect evidence over time and compare

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Thank you!

Questions?



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