

Notes for presentation:

211 lessons nominally;

Excel spreadsheet: boys in class 1974; girls in class 1786: boys asked questions 2354 girls asked 1592

How well do teachers understand assessment for learning: Christine Harrison professional noticing and responsive teaching

John's email 16/7

Hi Ruth,

I had a play around with it and ended up with  $\chi^2 = 80.82$  with 1 degree of freedom.

The critical value at 5% level with 1d.f. = 3.84 so the result is definitely significant - even at a critical level of 1% or even 0.1%.

In order to get this figure I added to the expected number of questions so that the total was equal with the observed. I split the difference between the observed and the original number of expected and added them to the boys and girls totals to give 2072 for the boys and 1874 for the girls.

le total students = 1974+1786 = 3760

% boys = 52.5% = 2072 expected Qs % girls = 47.5% = 1874 expected Qs

So that gave a matrix of:

	Boys	Girls
Observed	2354	1592
Expected	2072	1874

## **GENDERED SCIENCE TEACHING: TO BOYS OR NOT TO BOYS? THAT IS THE QUESTION**

*Science teachers are continually under scrutiny as researchers explore how they attempt to enable their students to 'do science' both in school and in preparation for 'becoming scientists'. Questions have been raised, for instance, about the tendency of boys to dominate in science lessons by gaining more of teacher attention compared with girls during dialogic interactions. Drawing on notions of gendered learning within the context of science teacher questioning, this research examines whether there is a tendency for teachers to address questions during classroom dialogue to boys over girls in secondary science classrooms. Data were collected in 211 science classes in London, UK. Pre-service science teachers mapped whom teachers asked questions to during randomly selected lessons, and reflected on their strategies and intentions. In addition, a teacher-researcher carried out teacher and student surveys and an in-depth student focus group interview in their school, in which 14-15 year old students are taught science in both mixed- and single-gendered settings, to examine any perceptions of gendered learning. Early evidence shows there may be a gender bias towards teachers asking boys questions more frequently, sometimes as part of behaviour management agendas rather than as direct scaffolding for learning ideas. Teacher perceptions of boys responding more readily to competitive learning were refuted by girls in our sample. Students did not perceive gendered grouping as aiding their learning or their enjoyment of it. This study has implications for*

*teacher training, and teachers' preconceptions of how girls and boys may respond to different learning approaches in the science classroom.*

**Keywords:** Gender Issues, Responsive Teaching, Motivation

## **SCIENCE CLASSROOMS, GENDER AND RESPONSIVE TEACHING**

Teachers face a host of challenges every day as they support students in understanding ideas, learning skills and becoming knowledgeable 21<sup>st</sup> century citizens. Science teachers have to embed a wide range of pedagogical approaches into learning science (Windschitl, 2010). Technological innovations, scientific literacy and mathematical explanations are all on the agenda, as well as the bread-and-butter 'big ideas' of, and about, science (Harlen, 2010). Teachers need to develop responsive teaching skills, which allow them to make decisions about promoting individual students' progress. These judgments require high levels of awareness and sensitivity in the classroom.

Educational research continues to raise questions about how teachers respond to the needs of different students. Teachers are often under scrutiny in terms of their intentions to teach inclusively with respect to gender, cultural and ethnic background, and special needs and disabilities. In science lessons, there is a long-standing focus on teaching girls and boys equably; for example, whether boys command more science teacher's time (Godec, King, Archer, Dawkins & Seakins, 2018) or whether girls or boys respond more favourably to practical activities (Robertson, 1987). The assertion is then that girls may feel science is not for them in environments which are male-dominated. Our study explores these issues across diverse schools in London, UK, in the context of teacher-student dialogue, in an attempt to contribute to the ongoing gender and science debate.

### **How does gendered teaching emerge in science lessons?**

Teachers are encouraged to anticipate multiple factors which impact on learning such as socio-economic background (Lupton & Thomson, 2015), parental support (Eamon, 2005), resources at home (Mohammadpour, 2013), and motivation for, and engagement in, learning (Hardré, 2011; Schumm & Bogner, 2016). Our research seeks to explore whether science teachers hold preconceptions about differences in how girls and boys learn.

Questioning is a key strategy in learning science, dependent upon dialogic interaction between students and teachers (Alexander, 2017). Concerns have been raised over whether science teachers distribute questions appropriately across diverse student populations (Archer & de Witt, 2014; Francis, Archer, Moote, de Witt & Yeomans, 2017); in other words, do science teachers' actions address the needs of both girls and boys in the classroom? Qualitative studies, by necessity, often examine single classroom-teacher cases. We began our research by mapping experienced science teacher question distribution between girls and boys in 211 diverse secondary (high) school classes in London, UK. In addition, an experienced science teacher examined teachers' perceptions of learning and teaching in mixed- and single-gendered groupings in their mix-gender school, with a view to highlighting preconceptions about how girls and boys experience learning in science. The teacher-researcher also sought the views of a small focus group of 14-15 year old students.

Research questions:

1. Are science teachers enacting gender bias during verbal questioning sequences in science classrooms?
2. What are teachers' and students' perspectives on student experiences of gendered learning in science lessons, as well as opinions on factors that support progress?

## **METHODS**

The study adopted a mixed methodology approach over two phases. In phase 1, quantitative data were gathered on experienced science teachers' questioning about science ideas and explanations through observational field notes recorded by three cohorts of pre-service science teachers (PSTs) in 211 lessons in London, UK. PSTs mapped the frequency of teachers' targeted and responsive questioning addressed to girls and boys, in randomly-sampled science lessons. Science topics across the whole curriculum were observed

(biology, chemistry, physics and earth sciences). The lessons occurred within a three week period in the autumn term (first semester) in each of three consecutive academic years. PSTs reflected on what influenced teachers' strategies and responsiveness in dialogic questioning. Questioning and dialogue play key roles in learning (Wiliam, 2006) so we considered this a fruitful lens for examining any gender bias. Inferential statistics are being used to analyse expected against observed question frequencies.

In order to build on phase 1, an experienced science teacher, (originally in one of the PST cohorts) researched teachers' perceptions of purposeful learning. The teacher also asked a group of 14-15 year old students (Year 10) for their opinions on what contributes to their progress in, and enjoyment of, science lessons. They explored impacts of gendered learning environments. The unusual feature was that the students studied biology in mixed-gender, and chemistry and physics in single-gender classes. Classes were taught by three different subject specialist teachers. We draw on field notes, teacher survey responses (n=18), and student surveys (n=26; 9 girls and 17 boys) and focus group interviews (n=4; 2 girls and 2 boys). Our analytical framework was developed from emergent themes drawing on gendered learning (Hart, 2016; Tichenor, Tichenor & Piechura, 2015) and student experience and motivations (Hardré, 2011; Ryan & Deci, 2000; Shirazi, 2017).

## FINDINGS

Data are being subject to statistical analysis to reveal possible gendered questioning as an indicator of any gender bias being enacted in the sample science classrooms. There is evidence coming forth which indicates some bias towards asking boys questions more frequently than girls. Full analysis will be presented. PSTs' reflections on the nature of teachers' approaches to asking questions equably to girls and boys included noting deliberative girl-boy alternate questions, questioning child-by-child, often with girls and boys sitting alternately, and random name generation (by selecting, for example, named lollipop sticks):

*The teacher promoted a very positive environment, where answering questions was encouraged; the girls in this class were very confidently answering.*  
 Mia, PST-observer

Instances where teachers focused more on students sitting positions, frequent answerers, and more able, verbally-confident students were also noted, as well as questioning as a behaviour management technique.

In phase 2 of the study, 39% of 18 responding teachers taught both mixed- and single-gender 14-15 year olds, 33% taught single-gender only and 28% taught mixed-gender only, allowing for a balance of perspectives and experiences. Teachers were divided in their feelings about students' progress in different settings, some favouring single- and some mixed-gender. Several suggested that boys learn better than girls through positive competition, but girls in the focus group disagreed with this notion. Aside from competition, one approach teachers reported using was shorter tasks for male groups, due to a perceived lack of perseverance over longer-term activities. In the survey responses, students rarely referred to gendered issues or environments when outlining factors which they felt contributed to their progress in, or enjoyment of, science lessons. Instead, commonly cited factors were teachers' enthusiasm and supportiveness, enjoyable subject content and 'doing well' in summative assessments:

*If I am more familiar with the people, I might feel more comfortable, and then with the teacher it's whether they are intimidating or encouraging.*  
 Student X, interview data

In the student survey, a small number of girls (n=4) stated they learnt better in single-gender classes, whilst the same number of boys felt the opposite; mixed-gender was their preference.

## DISCUSSION AND IMPLICATIONS

Our study reveals evidence showing that science teachers exhibited gender bias during questioning, across a diverse range lessons. There are therefore implications for initial teacher education and experienced science teachers' perceptions of equity in supporting girls' and boys' progress. Further exploration of possible differences in subject-related questioning, (for instance, whether teachers ask boys more physics, or girls more biology questions) may reveal more nuanced explanations of teachers' questioning strategies.

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