Good Girls Don't Get Ahead? Teachers' Perceptions of the Gender Gaps in Mathematics in Japan



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Abstract

Japanese girls lag behind their male peers in mathematics according to international tests such as the Programme for International Student Assessment (PISA). Japan's position near the top of the mathematics achievement rankings masks how it also has some of the biggest gender gaps in scores and attitudes towards the subject in the world consistently.

Despite this costly wastage of female talent, there is little attention paid - at any societal level - to understanding why such gaps exist or how to fix them. This research is the first to investigate this lack of response. While there is comprehensive research into how topics become problematised in Japanese society, including studies covering education (Kitsuse et al. 1984; Goodman 2012) and gender (Kinsella 2012) topics specifically, this research lends a new perspective by digging into why issues are *not* problematised. Answers are sought through semi-structured interviews with teachers to investigate the mechanisms behind why the gender-mathematics gaps at the school level have remained unproblematised.

My main empirical contribution is that teachers do (latently) recognise genders gaps like those described by PISA and Isa and Chinen (2014), but that these disparities are obfuscated by a combination of gender role expectations, teachers being discouraged from taking a gendered perspective, and the education system's structural features. This effect is exacerbated by there being little societal discussion, largely due to the topic being considered 'taboo'. The dichotomous STEM/Humanities track system, a major structural element of schooling in Japan which results in few girls choosing to continue study mathematics in high school and beyond, also affects teachers' interpretation of the resulting, de facto, single sex system. The gender gaps are not viewed as a problem because they can be seen as the result of girls' agency. Complicating this 'choice' narrative is a discourse of mathematics ability and interest differences between boys and girls as inherent and natural: good girls work hard at mathematics, but boys are talented at it and are expected to outperform them. Even when girls do better in classwork and tests, many teachers feel this does not correspond to being good at mathematics itself, explaining that girls have a shallower understanding and struggle to apply knowledge to unfamiliar questions.

Therefore, the common features of problematised issues in Japan - perceptions of unfairness; social undesirability and abnormality; and the resulting widespread public debate – are not present here. Good, hardworking girls making a free choice not to study mathematics is not a 'problem', especially as they tend not to possess the raw talent that boys do. However, many teachers *did* feel that the gender gaps were problematic and should be fixed but had not thought about the issue before their interviews.

A frequent comment was that they had never heard of, or engaged in, any discussion of the topic before. This thesis highlights how, although other countries have problematised much smaller educational gender disparities, Japan seems, at least on the surface, unmoved. This thesis provides an overview of the current barriers to problematisation that policymakers will need to overcome to fix Japan's gender gap: helping girls (and the Japanese economy) reach their full potential.

Chapter 1 - Introduction

How does a country with one of the most admired education systems of the last century, one with ostensibly equal access for both sexes, end up with one of the biggest mathematics achievement disparities in the world? And why does it seem that nobody is worried about it, or has even noticed?

Japan is, admittedly, not renowned for being a gender equal society. In fact, it continues to plummet down the World Economic Forum's rankings for gender equality year after year (WEF 2017 p.12; WEF 2019 p.9). The country now languishes near the bottom of the ranking of 153 economies due to its poor track record in women's participation and equality in the workplace, and women's political engagement and educational attainment in key areas (WEF 2019 p.9). Meanwhile, a key tactic in Japan's efforts to regain its economic glory days is to lean on women to compensate for the ageing population: both encouraging them into work and to increase the birth rate.

Despite excellent work on women's choices concerning the workplace (Brinton 1993; Shirahase 2014; Kodate and Kodate 2016; Nemoto 2016), scholars have focused less on the influence exerted by the earlier 'pipeline' in schools – especially for those industries which have had little luck increasing female participation. Just 14% of STEM (science, technology, engineering, and mathematics) university graduates in Japan are female (WEF 2014a), indicating that Japanese girls opt out of mathematics-heavy subjects and careers before university, with strong signs of disengagement appearing even as early as middle-school (OECD 2013b; Isa and Chinen 2014).

According to international testing, such as the OECD's triennial Programme for International Student Assessment (PISA), Japan's high overall mathematics scores hide the fact that it has some of the biggest gender gaps (in scores and attitudes towards the subject) in the world on a consistent basis (NCES 2019). Unconnected to these international studies, results from Japanese researchers Isa and Chinen (2014) and Uchida and Mori (2016) show the same disturbing pattern of previously confident, high-achieving girls finding themselves being outperformed by boys during their middle

school years. The pattern is similar for science subjects, and the gender gap is reversed (but no less severe) in humanities subjects.

In combination, these common-knowledge facts – big gender disparities in mathematics at school, disparities in STEM fields, potential skills gaps on the horizon – might suggest that this issue should be a priority for the government (and business) to fix. The intriguing thing is that, despite the implications for women's underemployment in economically important STEM professions, performance and attitude disparities between the sexes at the school level have prompted little in the way of reaction in Japan. Official data or commentary from government agencies is notably absent and media attention verges on non-existent. My research is the first to investigate this (lack of) response to these gender disparities; I use semi-structured interviews with teachers (and other key actors) to investigate the mechanisms behind why the gender-mathematics gaps at the school level have remained unnoticed and unproblematised.

I focus on the opinions of teachers; powerful actors in their own right considering both their direct influence on pupil outcomes, and their indirect impact via implementing grassroots reforms (or determining the success of government-led reforms). Prior research on teachers tends to centre on pupils themselves, focusing on teachers' direct impact on them via methods like classroom observation of teacher-pupil interactions (Morinaga et al. 2017). My research instead targets how teachers can make an indirect impact - teachers' perceptions affect the problematisation process in Japan, and those perceptions are determined by whether they recognise and conceptualise issues as problems or not. As practitioners 'on the ground', teachers' perspectives are invaluable to policymakers looking to close the gender gap, and their support is vital if any reform efforts are to succeed.

I use qualitative methods to investigate teachers' opinions of the situation in their own classroom; their assessment of their students' attitudes and achievement; and their view of the causes of the disparities described by tests like PISA. Semi-structured interviews are the perfect fit for this goal, allowing me to be responsive when investigating the shared beliefs of teachers and other key actors in the education system.

Whilst other countries have problematised much smaller educational gender disparities, Japan seems, at least on the surface, unmoved. There is extensive research documenting the problematisation of issues in Japan (e.g. Kitsuse et al. 1984; Toivonen and Imoto 2012), but not on why certain issues are not problematised. My research uncovers what is not being done, and what is not recognised or problematised in Japan. My research reveals a curious tension between everybody knowing about the gender gaps in mathematics, but nobody talking about it. As we shall see, many teachers even feel they are not allowed to discuss it.

Japan must focus on making the most of the human resources they already have. It is not sustainable to rely either on immigration (politically unpopular), or on raising the birth rate (generations of politicians have thus far failed). An obvious solution is to make better use of the existing population and women in particular, who have thus far been an underutilised resource. However, there is near-silence from government and media sources on the gender gaps in education despite evidence showing how school-level gender disparities contribute to employment imbalances. Therefore, my research will address an overlooked area in the literature on handling gender inequality in Japan that I intend to be convertible to real-world solutions.

With initiative missing from the top, I focus on the bottom by investigating what practitioners on the ground know and notice. My research finds that gender is an exception to previously assumed Japanese educational norms such as effort being the main component of outcome and contributes to the debates on conceptualisation of equality and to problematisation in the Japanese context. I also intend for my research to help equip policymakers with the information they need to fix Japan's gender gap: helping girls (and the Japanese economy) reach their full potential.

1.1 Research Questions, Theoretical Framework, and Summary of Contributions

The research questions of this thesis are: "What are Japanese teachers' perceptions of the gender gaps in mathematics?", including its subset "Do teachers see gender gaps in

mathematics?". And "What are the mechanisms contributing to these perceptions and the (non)problematisation of this issue?"

I use a modified version of problematisation theory, drawing upon previous examples of successful (and unsuccessful) cases of problematised gender and education issues in Japan, for my theoretical framework.

My main empirical contribution is that teachers do indeed report gender gaps in achievement and attitude of the sort described by PISA and Isa and Chinen (2014), but that their initial reaction is often that there are no differences. These interviews also uncover the fact that these gender disparities are obfuscated by a combination of factors including gender role expectations and the structural features of the Japanese education system. The situation was further buried by a lack of public discourse on the gender gaps, including no discussion of the issue in teacher training (or lesson study). The reasons for this range from the topic being 'uninteresting' or 'too expected', to it being 'taboo' to discuss – some even suggest that the government is deliberately withholding information. The dichotomous *bunkei*/*rikei (*Humanities/STEM) track system is a major structural element of schooling in Japan. The result of which tends to leave *rikei* classrooms with very poor gender ratios as few girls choose to continue to study mathematics at the high school level (and therefore not beyond either). However, these interviews uncover the fact that this system also has a profound effect on teachers' interpretations of the resulting, de facto, single sex system. That is: one of the major reasons that the gaps are not 'seen', and if they are seen they are not viewed as a problem, is because they are considered to be the result of girls' agency. Complicating this 'choice' narrative is a strong discourse of mathematics ability and interest differences between boys and girls as either inherent or inevitable: good girls work hard at mathematics, but boys are talented at it and are expected to outperform them. Even when girls do better in classwork and tests, many teachers feel this does not correspond to being good at mathematics itself, explaining that girls have a shallower understanding and struggle to apply knowledge to unfamiliar questions. A combination of these narratives means that it is fairly easy

to rationalise the gender gaps (which this thesis establishes that every teacher recognises to some extent), particularly as teachers feel they have little control over the issue.

Therefore, if we apply the framework derived from common features of problematised issues in Japan – perceptions of unfairness; social undesirability and abnormality; and a resulting widespread public debate sparked by powerful, invested actors – are not present here. A prevailing view is that good, hardworking girls making a free choice not to study mathematics is not a 'problem', especially as they tend not to possess the raw talent that boys do. However, many teachers *did* feel that the gender gaps were problematic and should be fixed but had not thought about the issue before their interviews. Teachers frequently remarked that the interview was the first time they had engaged in any discussion of the topic before at all.

1.2 Outline of the thesis

This thesis is organised into nine chapters. In this chapter we have seen that there are a series of related conundrums: that Japan is simultaneously one of the PISA tests' highest performers in mathematics whilst also (consistently) having one of the largest gender gaps in the world, that Japan is concerned about demographic issues and the future supply to the workforce, and that despite these facts there is no problematisation or movement to fix the gender gaps in mathematics. Chapter 2 provides a detailed look at the rationale for this study by further examining the economic case for addressing the gender gaps, an overview of the data evidence for the existence of the gender gaps, and the reasons that teachers are the focus of this study (as opposed to other important actors like parents, or the girls themselves). Chapter 3 presents a review of the relevant literature including: an overview of the studies looking at teachers' perceptions (particularly in mathematics) and positing this research within it, a trace of the evolution of notions of 'egalitarianism' in Japanese education over the last century and the implications for this thesis, an introduction to views on gender equality in education (including the backlash to feminist research which hindered further studies), and a detailed look at problematisation theory and how it applies in the Japanese context – which forms the core of the

analytic framework in this thesis. Methodology and details of the methods used in this study are found in Chapter 4, this chapter also includes an overview of the Self-Efficacy framework which contributes to my interview schedule.

From here we move into results and discussion. Chapter 5 presents the first part of the answer to the first of our research questions: do teachers perceive gender gaps in mathematics in Japan? The answer is, in short, 'sort of' – almost every teacher reported gender differences in achievement and behaviour and attitudes, but a majority initially stated that they did not think there were gender differences in achievement. This chapter also covers the most common reported differences and introduces the four themes that make up the results. In Chapter 6 we explore the first layer of teachers' perceptions and the mechanisms underlying them, covering two of the four 'themes' of teachers' explanations: personality and ability. This includes showing that teachers' ideal of a mathematics student (i.e., someone 'good' at mathematics) does not match up with their descriptions of girls, but that there are ways to rationalise this and prioritise other interpretations other than 'there is a gender gap' and 'there is a problem'. These reasons are: a kind of credentialism whereby many teachers use progress tests and classroom grades as the first (or only) metric to judge whether there are gender gaps in achievement or not; that teachers do not consider gender consciously when looking at their classrooms – something that hides commonly reported differences such as the grade gap widening over time; and that whether teachers view the causes of the gender gap as (practically) inevitable, or out of their own control, and how this affects non-problematisation. Through presenting whether teachers think the gaps can be fixed, how they would be fixed, and whose responsibility it would be to fix them, this chapter also shows that the problem is not as simple as teachers believing there is nothing they can do about the gender gaps.

In Chapter 7 we focus on the other two themes of teachers' explanations: interest and choice. We uncover another angle to teachers' perceptions and the mechanisms underpinning them: the impact of the *bunkei/rikei* tracking system and how, when girls' agency is foregrounded as an

explanation, this allows teachers to rationalise the gender disparities they see. Here, we revisit how ideas of credentialism (this time, it is teachers' perception of girls' own credentialism), the difficulty of seeing the disparities *as* gendered, and how a feeling that the systems are too embedded to change, blocks both problematisation and recognition of the gender gaps. Chapter 8 takes a step back to see the environment that teachers operate in, delving into the lack of societal discussion and the two overarching mechanisms underpinning both streams of rationalisation: an overarching culture of Genderblindness/Taboo and a sense that the gender gaps are mundane and not worthy of attention. We also tie up threads from the last two chapters showing another element to the dearth of discussion: the lack of cooperation and discussion between different actors (including between teachers, and between teachers and the government) in this issue. Chapter 9, the conclusion chapter, ties these ideas together, compares against successful cases of problematisation and presents a case for a revised model for non-problematisation in the Japanese context.

The next chapter, the Rationale, includes an in-depth exploration of the reasons that fixing the gender gaps in mathematics can be considered an economic imperative. This section also provides an overview of the data showing the gender gaps in mathematics achievement and attitudes. Finally, we will also cover why teachers are the key to understanding the situation surrounding the non-problematisation of the gender gaps.

Chapter 2 - Rationale

2.1 The Economic Argument

Maths matters. It is a prerequisite for developing the vital science, technology, engineering, and mathematics skills increasingly in global demand as developed nations' economic bases shift towards technical and financial industries (Tyson et al. 2007; Powell and Snellman 2004; Sells 1980 in Watt et al. 2006). Japan also faces demographic crises which will exacerbate current STEM skill shortages. One of its best hopes is to encourage women into these fields where they are currently underrepresented (Homma et al. 2013; Kodate and Kodate 2016).

Japan faces a dilema: its gender inequality is estimated to be costing the Japanese economy $550 billion annually (WEF 2017, p.27). According to the World Economic Forum's (2019, p.31) insight report, "Japan's gender gap is by far the largest among all advanced economies" and continues to widen – Japan currently languishes near the bottom of 153 economies due to its poor track record in women's participation and equality in the workplace, political engagement, and higher educational attainment. The country is ageing, and the population is shrinking. Politicians have leaned on women in two (seemingly opposite) directions: expecting them both to work to make up for shortfalls in the male working population, and to have as many children as possible. Despite decades of political concern, birth rates are proving stubbornly difficult to budge from their current low level (Schoppa 2006).

Persistent gender inequality is threatening Japan's economic future; it cannot afford to squander talent just because it is in a female body. The gender imbalance in STEM (science, technology, engineering, and mathematics) fields in Japan is one such area where we can see where the workplace has become particularly polarised.

Women are underrepresented in STEM fields throughout much of the world (Charles and Bradley 2009, p.940; WEF 2014b). However, Japan has one of the bigger imbalances - just 14% of STEM graduates are female (WEF 2014b, p.221). Former Prime Minister Abe Shinzo attempted to address the wastage of female talent as part of the 'third arrow' of his economic policy:

Abenomics (Abe 2013; Aldrick 2014). The reasoning behind this policy is that increasing women's participation in the economy will be a vital step in offsetting the declining working-age population and widening the talent pool to increase productivity (Patrick 2014:17).

Although there have been attempts to encourage women into STEM fields, this has had mixed success (Homma et al. 2013; Kodate and Kodate 2016; GEBCO 2018). It is true that retention of female STEM workers and researchers is a serious problem, particularly the experience of mothers trying to combine work and childcare – some institutions have taken steps to combat this, but efforts are still largely left up to individual workplaces (see Ochanomizu University 2021; Fuji Electric n.d. for some examples). However, the ability to retain and support female STEM workers is hugely dependent on having enough of them in these industries to retain in the first place; workplace imbalances largely have their roots in academic imbalances and choices made by individual students earlier on (Sells 1980; Watt et al. 2006; Kawaguchi et al. 2014). As in many countries around the world, girls in Japan opt out of mathematics (and mathematics-heavy subjects) long before they reach even undergraduate level, let alone the postgraduate degrees that are the norm in many fields. There are even signs of this disengagement with STEM subjects appearing as early as middle-school (OECD 2013b; Isa and Chinen 2014).

Why is mathematics the subject to focus on, as opposed to science? Dubbed the 'Invisible Filter' by Sells (1973; 1980, p.340), mathematics is considered internationally to be a critical factor in determining the choice to enter STEM related careers (Watt et al. 2006). The content of many STEM subjects is built off, and requires, good levels of mathematical competency. The studies that have investigated the 'leaking' STEM pipeline in Japan suggest that there are significant differences between boys and girls in their achievement in, and in how they feel about, mathematics. They also speculate that attitudes around girls and STEM may have contributed to these differences and resulted in gender disparity in the workplace of these fields (Isa and Chinen 2014; Kawaguchi et al. 2014; Sakata 2014).

For reasons we shall explore in Chapter 7, mathematics also has a disproportionate effect on pupils' decision making about their futures in Japan – being bad at mathematics seems to put students off STEM subjects in general. The way the education system is set up encourages this.

The circumstances surrounding Japan's famous postwar 'economic miracle', the sources of the country's meteoric success, (and later the blame for its fall), are still a source of fascination – and disagreement (Johnson 1982; Flath 2005). However, one common argument found in discussions by academics and laypeople alike is that although Japan was not blessed with an abundance of natural resources, it made the very best use of its *human* resources (Levine and Kawada 1980). Japan's education system has therefore played a core role in the country's economic successes through the years; it must 'produce' human resources to meet its changing economic demands. In the past, such as in the postwar era, this meant equipping people with a solid base for skilled manufacturing work.

However, like many other advanced economies, Japan has had to shift towards being a 'Knowledge Economy': focused on the production and skilled application of knowledge, rather than industrial production and manufacturing (Powell and Snellman, 2004:199). Although many countries have looked to immigration to fill skills shortages (like those in STEM), this solution remains unpopular in Japan (Abella 2012; Green and Kadoya 2015). Female workers have long been used as a kind of 'buffer' protecting a core male workforce. However, a knowledge economy needs a wide talent pool, and the demographic pressures mean Japan cannot afford to waste the skills and intelligence that women can bring to STEM industries. Now, Japan must ensure that its graduates are ready for knowledge-intensive work in STEM fields in a competitive global economy.

Whether or not women are simply worse at mathematics is an important question to address here – it has certainly been a common assumption over the years. Mathematics is often stereotyped as a 'masculine' subject, one that women and girls struggle in and have less aptitude for – these are also commonly held views in Japan (Nosek et al. 2009; Sakata 2014; Morinaga

2017). The interviews in this thesis reinforce the image of the subject as highly gendered, and understanding this is vital to appreciating the mechanisms underlying non-problematisation.

One oft-used explanation for women's poorer mathematical performance is that there are brain differences between the sexes that cause performance differences – dubbed 'neurosexism' by Fine (Fine 2010; Miller and Halpern 2014). In 2005 Harvard University's President, Larry Summers, stated during a speech that there were "issues of intrinsic aptitude, and particularly of the variability of aptitude" concerning the dearth of women in science and engineering (PBS News 2005). Although reaching for biological reasons for performance disparities is common, there are meta-studies which suggest that this is not true – or at the very least too simplistic. Researchers suggest that men and women are equally capable of mathematics, and that many of the most famous gender differences (such as men and women's differing spatial awareness) are socialised, "small, and declining" and "responsive to training" (Linn and Hyde 1989, p.26; Hyde et al. 2008; Hyde and Mertz 2009; Lindberg et al. 2010)

If it is true that the dearth of women in mathematics-heavy fields cannot be (at least fully) attributed to inherent, biological differences, then the STEM gender imbalance has not only important economic implications but social ones. Japan's gender/wage gap one of the largest amongst OECD countries (OECD 2013c; OECD 2021), and underrepresentation of women in STEM fields could well be a part of that. More importantly still, if it is not biological differences that cause the imbalance then there must be other reasons that otherwise capable girls are filtered out – and there must be a way to address it.

Mathematics skills are vital for Japan's economic health, and demographic pressures mean that Japan needs female workers able to meet this requirement. If girls are opting out of mathematics early, we must examine why and how this happens at school – beginning with an examination of the current state of mathematics education in Japan. To shift its educational system to fix the gender imbalance in STEM, Japan needs a greater understanding of the core problem: the imbalance of girls continuing to higher levels of STEM study. Despite this, there has

been little urgency around finding a solution to these problems, and seemingly little discussion at all. Before the problem of the gender gaps can be addressed it needs to be thought of as a problem – and the reasons that it is not already considered such need to be investigated.

2.2 Overview of the Data on the Gender Gaps

This thesis investigates how teachers perceive the gender gaps in mathematics, but for that to be possible there actually has to be gender gaps for them to perceive. In this section we will review the evidence supporting the existence of achievement and attitudinal gender gaps in mathematics in Japan, including data from international testing and from Japanese studies.

2.2.1 Independent Japanese Studies

Few studies confront the gender gaps in mathematics in Japan specifically. Researchers who have conducted work in this area comment themselves on how the topic has been overlooked – not just in academia but also by the government (Isa and Chinen 2014; Uchida and Mori 2016).

Isa and Chinen (2014, p.90) followed both test results and attitudinal information collected from a set of students as they moved through elementary and middle schools in a single city. They found that there were no clear achievement gender differences for mathematics in elementary school, but girls preferred *kokugo* while boys preferred mathematics. Girls' dislike for mathematics intensified throughout middle school and this was also mirrored in widening performance disparities. At the beginning of middle school there is no gender gap in achievement, but this widens during second and third year with boys scoring higher. Girls' motivation in mathematics is higher than boys' in their first and second year, but significantly lowers in their third year.

Uchida and Mori (2016, p.101) tracked 2,000 middle-school pupils' test scores in several subjects, including mathematics. They found that girls were underrepresented in the top quartile of performers, and overrepresented in the bottom quartile. Boys outperformed girls in every quartile throughout the three years that their study covered. However, the top quartile originally had the smallest gender gap which then rapidly widened throughout the second, and especially third, year. The middle quartiles had larger initial gender gaps in the first year, these shrank

somewhat before holding mostly steady throughout middle school. The bottom quartile had the largest initial score difference between boys and girls, and the smallest by the end of middle school. The top two quartiles had a larger gender gap than they started with, and the bottom two had a smaller one. The only group of girls who improved their scores relative to boys were the those in the lowest quartile, the only boys were those in the top quartile.

2.2.2 International Test Data

From these two studies using Japanese data we can see that there is evidence that a gender gap either appears or intensifies during middle school years. In addition to those studies conducted in (and about) Japan there is also evidence for gender gaps from large-scale international tests of academic performance. Two such tests frequently used by researchers are the Organisation for Economic Cooperation and Development's (OECD) **P**rogramme for **I**nternational **S**tudent **A**ssessment (PISA) test, and the **T**rends in **I**nternational **M**athematics and **S**cience **S**tudy (TIMSS) tests. Both tests examine children's mathematics performance - but have different assessment goals and test slightly different target age groups(NCES 2007; Grønmo et al. 2013)

PISA is a large, triennial study testing 15-year-old students' mathematical, scientific, and native language (*kokugo* in Japan) ability level at the end of their compulsory education. PISA tests do not focus on testing curriculum content, but instead attempt to gauge students' ability to apply their knowledge to real-world problems (OECD 2014). PISA collects pupil, school background, and attitudinal information, making it an oft-analysed data source for education researchers (Baird et al., 2016).

While PISA looks at mathematical literacy (application ability of textbook knowledge), TIMSS tests how well 9 and 14 year olds have learnt and understood the mathematics that underpins that literacy – testing for their mastery of curriculum content (NCES 2007; TIMSS 2011). Despite their differences, the gender disparities highlighted in these two tests in Japan are worthy of note.

We will turn first to PISA, as the results of 2012 test was the original inspiration for this research. Since testing began in 2000, PISA has reported significant gender gaps in mathematical literacy between boys and girls in Japan. This was initially a surprise to me considering Japan's consistently high scores overall in mathematics.

Each cycle, the PISA tests focus on a different area: mathematics, national language, and science. PISA 2012 focused on mathematical literacy, meaning it also collected detailed attitudinal (and other) statistics which were analysed along with the raw test scores. Japan's average score was 536 points (boys 545, girls 527). This left a large gap of 18 points, which was almost double the OECD average of 10 (OECD 2013a, p.2; NCES 2019). Since then, there have been two subsequent PISA cycle test results released and Japan's status as having one of the biggest gender gaps in the study has remained stable. Japan remained one of the strongest performers overall in mathematics in PISA 2015, overtaking South Korea to gain the top spot amongst OECD countries. However, Japan had one of the largest gender gaps in the world (again, nearly double the average), at 14 points. PISA 2018 results, released December 2019, show that Japan's gender gap was once again exactly double the OECD average. The gender gap shrank to 10 points, but the OECD average narrowed in proportion too – coming in at 5 points (OECD 2019, p.5). Japan's gender gap in mathematics achievement has therefore been, consistently, much larger than the OECD average for years.

It is possible that Japan's PISA mathematics gender gap is the result of its high achievement overall. Males could simply outperform females at higher levels, and Japan has higher performance on average, which could then cause a large gap. However, the country with the largest 2012 gender gap favouring boys (Chile) had low overall scores. Luxembourg and the UK had similar average scores, but the former had a very large gender gap while the latter had the OECD average. Likewise, countries with higher average scores than Japan, like Singapore and China (Shanghai, Beijing, Jiangou and Guangdong), have much smaller gaps at 0 and 6 respectively (NCES 2019).

The PISA data also showed that the gender gap varies depending on question type (OECD 2013d, p.166) and analysts found a wider disparity in questions requiring children to "formulate mathematical concepts" with especially large gaps in questions dealing with shape and space. Likewise, on average, the gender gap is smallest when asking students to solve calculations and equations or to present data mathematically, and largest when questions require problem solving (OECD 2015, pp.89–91). This is not only supported by the teachers interviewed for this thesis, but also by several of the researchers. One renowned mathematics education researcher (SM.R) noted that not only did question type make a difference, but the theme of the applied question also did: girls did better at "pure mathematics" and that there was a "very large gender gap in Japan [on a question] about a racing car"

The other major international study looking at mathematics, TIMSS, also shows gender score differentials in Japan. Boys have outperformed girls at age 14 in every set of TIMSS results in mathematics and the gaps have been larger than the global average (excepting 2015, where the gap was not statistically significant). Boys were also confident in (and liked) mathematics to a greater extent than their female peers (NCES 2019).

Japanese researchers have also used PISA and TIMSS datasets to conduct studies tailored to Japan. Hojo (2013, p.9) uses TIMSS and PISA data to examine the gender gap in Japan and compare it to the United States. His findings align with the aforementioned Japanese studies uncovering achievement and attitudinal gaps widening through middle school. Japanese girls were more negative about, and had lower confidence in, mathematics and this feeling intensified as they moved through the school system. Meanwhile, Tobishima (2014, p.374) looked at how the interaction between gender and class influenced educational expectations. Boys, particularly those in higher socio-economic brackets, had higher expectations. Girls had lower confidence, regardless of their actual attainment, and this lower confidence also explained a large part of the gendered variation in educational expectations even when controlling for attainment.

This gender gap in confidence plays a particularly important role in this thesis. This is a reflection of the fact that OECD analysts flagged the confidence metric of 'self-efficacy' (SE) as being more influential on scores in Japan than the OECD average (OECD 2013a, p.7). The OECD found girls (globally) were more likely to have low SE, and that this varied by question type with girls having higher SE on pure/classroom content, and much lower SE on applied mathematics (OECD 2013b, p.83). They also reported that SE had a greater effect on students' performance on students from higher socio-economic backgrounds (OECD 2013d).

Data on self-efficacy was collected using self-reported questionnaires - with students asked to rate their 'confidence' level when solving different types of mathematical literacy questions. In Japan, consistent with the smaller achievement gap in these areas, girls reported slightly higher SE than boys in solving linear and quadratic equations. Conversely, Japanese girls were considerably less confident about questions applying mathematical thinking. Strikingly, as with their female peers across the OECD, girls had even lower confidence when questions could be considered gendered e.g., calculating the petrol consumption rate of a car (OECD 2013b p.83).

Looking at the PISA data, the gendered differences in confidence explain more than half the achievement gap in mathematical literacy. Controlling for self-efficacy drops the 2012 score point difference from 18 points to 8 (OECD 2013d, p.TableIII.7.5e). Unfortunately, we do not have data like this for either PISA 2015 or 2018 as mathematics was not the cycle's focus those years.

2.2.3 Data Complexities

Is there evidence against the existence of gender gaps in achievement and attitudes in Japan? National Testing in Japan was reintroduced in the 2000s following a 40-year hiatus. It examined children on mathematics and Japanese literacy, and conducted detailed surveys of student demographics, attitudes, and behaviours. However, there is no breakdown of data available by sex – despite detailed breakdowns by prefecture, school type and cross-tabulations of this information with detailed school questionnaires (including whether children eat breakfast or not).

There are some data on the links between SES and scores, but official statistics and reports do not mention gender at all (MEXT 2017, p.13).

Following PISA 2009 results, MEXT did publish one commissioned study that included gender as part of a report on educational attainment using National Test data (Shimizu et al. 2010). No significant gender gaps were found in mathematics tests, but they were found in Japanese literacy. They note that the latter finding is consistent with PISA's gender gap in literacy (boys outperforming girls). We will discuss the attention paid (or not) to gender gaps in mathematics by the government and the media in Chapter 8.

It is worth noting that National Tests commissioned by governments are usually (and understandably) matched to their curriculums and the current goals of their education system; there is a precedent of this obfuscating performance results. Hyde and Mertz (2009, p.8802) investigated the United States' standardised tests; every child in the country was tested annually with results showing only tiny gender (and ethnic) gaps in mathematics achievement. Closer investigation revealed that these tests contained almost no 'complex problem solving' (where girls suffer in the PISA tests) and they suggested data from different tests would be necessary to get a fuller picture of minority groups' performance in mathematics.

Like self-efficacy, we shall see that the content of the mathematics being tested is a core finding amongst teachers' perceptions in this thesis. Application content and the difference it makes to gender gaps is also highlighted by the international test data we have reviewed here. Although both international tests reveal a long history of mathematics gender gaps in Japan, juxtaposing TIMSS and PISA shows that the performance differential between boys and girls only becomes very large when the questions focus on mathematical problem solving (as it is mostly in PISA tests). As mentioned previously, TIMSS tests on curriculum content while PISA focuses on application of classroom knowledge and mathematical thinking (NCES 2007; OECD 2014, p.2).

We can see from the studies we have looked at in this section that the aims of tests, and the types of questions that they measure for, matter to whether gender gaps appear. We have also seen that independent tests conducted by researchers in Japan and the large international tests both show gender gaps in achievement and attitudes in mathematics.

2.2.4 Other Uses for the Data

The utility of the PISA test for the purposes of this thesis goes beyond what it can provide in terms of evidence for achievement gaps. PISA and TIMSS are well regarded and politically influential data sources, but PISA's strong influence on education policy worldwide has attracted it significant scrutiny - sparking academic debates on translation accuracy; sampling measures; model improvements and its usefulness for policymakers (Bonderup-Dohn 2007; Baird et al. 2011, p.8; Baird et al. 2016). Nevertheless, the announcement of PISA results attracts global attention, the media jumps on changes in international rankings, and governments publish their own coverage of the data. The results can be very influential on education systems and Japan is no exception. Most famously, a wave of public panic triggered by the PISA 2003 results showing Japan slipping down global rankings caused a phenomenon known as the 'PISA shock' – which ostensibly caused the Ministry of Education to reverse its education reforms. However, academics argue that the furore was also harnessed by the Ministry of Education to push through controversial reforms that they already wanted (Takayama 2008; Knipprath 2010). PISA is often used as a tool by the government, interpreted in such a way as is either useful, or fits the prevailing societal mood. The government does not just use negative PISA (and similar) results to justify change, but also uses positive ones to 'prove' that their policies are working. It used the TIMSS 2007 results to say that the changes they made since the poor showing of PISA 2006 had managed to turn students' dropping academic ability around (Knipprath 2010, p.402).

In combination, these studies form a strong case that there are indeed gender gaps of which we can gauge teachers' perceptions, and they provide clues as to what areas should be probed during interviews.

2.3 Teachers' Role and Importance in the Japanese Education System

Now that we have established that it is plausible that there are gender gaps in mathematics in Japan, the studies cited are tools for exploring teachers' perception of them. In this section we must justify why it is worth focusing this exploration on teachers, rather than on the children themselves like many other studies, or on their parents.

Teachers are arguably the most important actors within an education system. They can affect their pupils' performance directly, but also influence their pupils' confidence and other attitudes towards their subject. In Japan especially, teachers also inform educational policy which means an indirect impact outside their own classrooms. Teachers' views are the perfect middle ground between too close to the issue of the gender gaps (girls themselves or their parents), or too far removed from what is happening on the ground (government); neither too narrow nor too broad to be useful for digging into this issue. Considering their power, this thesis is interested in what teachers think and feel about the gender gaps.

2.3.1 Teachers' Impact on their Pupils

One of the key ways for teachers to improve their pupils' performance is by nurturing positive attitudes towards mathematics. Encouraging effort and persistence, a healthy self-evaluation following failure and other setbacks, and imparting enthusiasm for the subject matter are just three of the main ways teachers can do this (Pajares 2006). All these things are also a part of improving the self-efficacy of children, in the previous section we saw that this trait affected the gender gap in mathematics in PISA. We will take a closer look at the mechanisms of SE formation in section 4.1.2, here it is sufficient to say that teachers can have a lot of control over this process in their pupils.

Lots of research has been done on the 'Japanese style' of mathematics teaching, much of it during the 1980s and 1990s buoyed by the interest in the source of Japan's economic miracle. A distinctive finding in this research is that teachers, parents, and pupils themselves tend to support the idea that hard work (rather than innate ability) is what gives you success in mathematics. Japanese students are nurtured to be tenacious: experiments with impossible questions had to be

halted as the Japanese students persisted long after their American counterparts had given up. Japanese students attempted fewer questions, but got more of them right (Stevenson et al. 1986; Stevenson and Stigler 1992, pp.105–6). The Japanese educational norm of effort leading to outcome is key to bear in mind when we go through the interview data.

A typical Japanese mathematics class involves the teacher presenting an unfamiliar problem and allowing children time to experiment with finding the answer – typically in small groups. Teachers only step in when students continue to struggle, otherwise they are expected to use their prior knowledge to attempt different solutions. Students then present their solutions to the whole class, the ideal being that (in a mixed ability class) all students benefit from the diverse perspectives. This style gives students some independence from their teacher, whilst still being collaborative in a way where pupils benefit from 'teaching' each other, and is designed to develop a deeper understanding of how mathematics actually works rather than simply how to answer that particular question (Whitburn 1995; Stigler and Hiebert 1999; Whitburn 2000; Cave 2007; Takahashi 2017).

Aside from the resemblance to self-efficacy building techniques, knowing this goal is crucial for understanding teachers' perceptions. Creating deeper understanding of how mathematics functions and the application of previously acquired knowledge in unfamiliar situations will be a core topic in the interviews. It is also, as we saw in the previous section, highly relevant to the types of skills that the PISA test is trying to examine.

We will examine the history of egalitarianism in Japanese education more closely in the next section, but we can see traces of it even in the format of how Japanese mathematics classes are taught. Traditionally, teachers aim to improve the abilities of the class as a whole, rather than focusing on maximising individual students' potential (Whitburn 2000, p.251). Cave (2016) noted that teachers were largely not on board with reforms that wanted them to concentrate on individuals more, and that in his fieldwork in Japanese schools he frequently saw teachers allowing stronger students to run out of classwork while they helped weaker students.

2.3.2 Teachers' Impact on the Education System

Teachers in Japan have two ways of affecting practice outside their own classrooms: their ability to influence national education reform, and their involvement in continuous education and training with networks of schools.

Top-down educational reform has a mixed track record, with policymakers tending to underestimate the difficulty of implementing the changes they want to make. Successful educational reform should be "professionally developed change, rather than administratively driven reform that professionals then have to deliver" (Hargreaves and Shirley 2012, p.122). Teachers, therefore, can be considered the key to successful educational reform; and this is particularly true for Japan. Any changes that would be made to address the gender gaps in mathematics would have to go through teachers.

The 'relaxed education' policy in Japan provides a cautionary example, doomed in large part due to teachers' dislike of it. Teachers were not adequately consulted in the policymaking process, and many disagreed with the ambitious goals that they were set. In line with the historically more egalitarian ethos, teachers were more interested in the development of the whole class and viewed targeted individual development as a nice but unrealistic goal. Those who were on board with the policy were disheartened by how little work their students did following implementation (Cave 2007; Cave 2016, p.221). Here, a gap between policymakers and teachers' views prevented smooth implementation and resulted in unintended consequences. The extent to which teachers' were overlooked is clear from the fact that only one teacher sat on the review board during the policy evaluation phase (Kariya 2013a, p.137). Similar problems occurred in the early 1960s when the government first tried to bring in National Testing; ostensibly the goal was to discover and nurture talent, but teachers were sceptical about differentiating children by ability in this way. When it came time to run the tests, many teachers resisted – in some prefectures almost every school refused to take part. Teachers joined parents to argue the test

was illegal, and the Ministry of Education had to abandon plans for collecting comprehensive data from all schools (Okano and Tsuchiya 1999; Okada 2012, p.92).

Clearly, any attempt to effect broad change from the top-down must be made by involving teachers in the policymaking process, by taking their valuable first-hand experience into account, and obtaining their buy-in to the policy. Aside from their role as reform implementers, teachers in Japan also participate in grassroots, bottom-up educational change – particularly 'Lesson Study' – which we will examine next.

'Lesson Study' is a form of continuing education for teachers as practitioners. It is a collaborative process whereby teachers form groups (either within a school or a network of local schools) to plan, observe, and discuss each other's lessons. The rationale is that teaching quality is raised most efficiently by practitioners pooling their knowledge and sharing their expertise. These groups also often publish and present their findings at academic conference (Stigler and Hiebert 1999, p.111; Fernandez and Yoshida 2004, p.7; Isoda et al. 2007, p.xvi; Okubo 2007, p.20).

Isoda (2007, p.xvii) explains that around half of middle-school mathematics teachers are estimated to spend at least two hours a week on LS meetings in after-school hours and personal time. There is a strong culture that teachers must work on improving their craft, and continue training, even after their formal education has finished (Takahashi and McDougal 2016). This is supported on an institutional level; internally schools facilitate this process and there are also inter-school biannual 'open forums' where the accumulated knowledge can be shared between groups and with teachers who have not directly participated in the research project (Isoda et al. 2007, p.xviii). This is a continuous, incremental type of teaching improvement rather than one of radical reform – presumably embedded in the same culture as *kaizen* from the business world. Like its business cousin, this type of change has the same power to allow good ideas and good practices to spread, even to make it up to the level of policy. Lesson Study is largely practitioner-generated, so topics reflect issues teachers encounter on the ground. Therefore it seems to be

precisely the kind of practitioner-generated change, versus top-down reform, that Hargreaves and Shirley (2012) highlights as effective for educational change.

Teachers also have the advantage of being close enough to the situation 'on the ground' to be able to give a detailed account and have opinions informed by first-hand experience of the classroom. However, they are also still removed enough that they can provide a broader perspective formed through watching generations of students – without the narrow, invested viewpoints that children or their parents would have (after all, they only have that one data point to go off).

Not only do teachers have the power to directly affect their pupils, they also have the power to affect or hinder changes further afield. However, both approaches require teachers to be aware of the gender gaps, and also to consider them a problem. The next chapter will focus on how issues like the gender gap can become problematised, the history of educational equality in Japan, and the current status of research on gender and mathematics.

Chapter 3 - Literature Review

3.1 Positioning this Research and Related Studies

As discussed in the previous chapter, there has been little concern over the mathematics achievement gender gap, and the limited research that has been conducted does not consider teachers and their role at all. There is, however, plenty of work on how teachers' beliefs impact on pupil outcomes generally, both internationally and in Japan. Teachers hold gendered views on mathematics, and this does affect how they treat their pupils (Zhang et al. 2013). There are findings that teachers are able to transmit their own gendered attitudes onto their pupils, (Fennema and Carpenter 1998; Bohrmann and Akerson 2001; Keller 2001; Gunderson et al. 2012) and that they play a crucial role in developing children's attitude towards, and confidence in, mathematics (Fennema and Peterson 1986; Bandura 2006; Pajares 2006; Huang 2013).

When it comes to studying teachers' views themselves, on the international side: Fennema et al's (1990) influential research (and later Espinoza et al (2014)) found teachers had mixed success in evaluating their male and female students accurately, and that they tended to attribute boys' success to ability and girls' to effort. Other studies focus on how teachers' own sex (Li 1999) or their level of experience (Georgiou 2008) affects how they view their pupils, and their expectations of their performance. The former finds minimal differences (in that both male and female teachers tend to overrate boys' ability), and the latter substantial ones (older teachers are more likely to think gender impactful, and to focus on inherent and unchangeable qualities like intelligence). Hamilton et al (1991) compared how teachers treat boys and girls in Japanese and American elementary school classrooms, finding that teachers in both countries paid more attention to boys (both positive and negative) and that the differences between boys and girls were larger in Japan than in America.

In Japan, work combining mathematics/gender/teachers is rare and the topic has generally

only been mentioned as part of larger, broader studies. Tsuru et al (1971) found in their paper on gender issues in education that teachers felt strongly that boys and girls were good at different subjects, and that boys and girls took a different approach to learning. Unusually, teachers thought that mathematics gender gaps gradually faded away through middle school, whilst boys remained 'overwhelmingly' dominant in science and girls 'overwhelmingly' outperformed the boys in *kokugo*. Tatano and Tahara (2001) surveyed teachers about their beliefs on a number of subjects. Amongst their findings were that 62% of male teachers and 74% of female teachers felt that boys and girls had equal ability in mathematics, but that 30% of male (and 24% of female) teachers felt that mathematics was a 'male strength'. Only four percent of male teachers – and none of the female teachers – felt that mathematics was a 'female strength'. Finally, 75% of male and 80% of female teachers said they had never had any training on gender equal education. Mathematics is not a focus of either of these studies, and due to their breadth and research goals they can only provide brief hints (Tsuru et al), or present tantalising statistics without much commentary (Tatano and Tahara). My research focuses specifically on digging into the kinds of views that these studies find as by-products of their research – what are teachers' perceptions of this intersection of gender/mathematics and the impact this has on their problematisation (or lack of it, as it turns out) of the gender gaps.

There is a precedent for this kind of approach of interviewing teachers about aspects of educational equality. There was a particular interest in the United Kingdom during the 1980s [1](Walden and Walkerdine, 1985: Clarricoates, 1980; Riddell, 1989). This international research using in-depth interviews with teachers (including mathematics teachers) includes Riddell's (1989) study on teachers across multiple subjects in two English schools in the 80s. Hauntingly, some of the quotes from her interviewees - gathered 30 years prior to, and on the other side of the world to my research – echoed my own research. Although not specific to mathematics,

[1] The title of this thesis was inspired by a self-help book written for career women during this era of interest (White 1995)

Clarricoates (1980) and Riddell (1989) find (as I do) that teachers have very different assessments of girls' characters and their ability and talent for learning: girls might be quiet, hard-working, and reliable, but the adventurous, independent, confident boys are the ones who are actually good at mathematics. Much like my study, Walden and Walkerdine (1985) researched what is happening to girls between primary school (when girls did well at mathematics), and secondary school (when girls' performance and their rates of continuing with mathematics dropped). As part of this investigation, they interviewed mathematics teachers – as Fennema would later find, teachers viewed girls and boys differently and attributed their successes to different character traits and approaches. "Girls are…taken to produce a good performance but for the wrong reasons" meaning that girls' rule-following approaches to mathematics were "regarded as the wrong kind of learning" (Walden and Walkerdine 1985, p.12). They found teachers were reluctant to rank their students (as it would mean admitting they did actually differentiate), that they had different standards for male and female pupils' neatness and compliance, and that boys were described as talented, while girls were conscientious. Finally, boys were seen as being (genuinely) interested in mathematics, and girls only interested for 'instrumental' reasons such as the O Level exams (Walden and Walkerdine 1985, p.61). In the course of his research focusing on Japanese middle schools, although not specific to mathematics, Cave too found that teachers thought of their pupils differently based on their sex – describing girls as harder to handle, 'cliquey', and prone to holding grudges (Cave 2016, p.64). In a previous study in Japanese elementary schools, teachers had asserted that they treat children the same – regardless of gender – but Cave (2007, p. 168) found that in practice this approach often resulted in children being treated differently (i.e. teachers preferred volunteers and it was generally boys who put their hands up).

Governmental and public problematisation of gender gaps in literacy in the UK have seen researchers responding to these concerns over boys' lagging academic achievement in literacy by using qualitative interviews to gauge teachers' perspectives on the gender gaps in that area

(Hamilton & Jones, 2016; Younger et al., 1999). In Japan we see the reverse of this, where there is a lack of public problematisation, and it is this which is triggering this research.

My research's closest 'relative' in Japanese academia is on the science side, rather than mathematics. Kato and Yoshida's (2003) investigation into girls' decision making around continuing with science (as a subject) included interviews with their teachers as a supplement to girls' interviews. They found that teachers felt girls disliked science and had noticed gendered behavioural patterns during class. Meanwhile, Tsumura & Fujii (2015) and Inada (2008) stress the importance of developing teacher training programs to get teachers to think of their girls and gender equality in science lessons.

There is also research focusing on gender-neutral education, more specifically, the barriers to developing and implementing it successfully in Japanese schools (Kimura, 2009, 2010; Kimura & Naoi, 2009; Taga, 2003). These studies find that teachers are generally on board with the surface level de-gendering – such as not using gendered suffixes – but still policed gendered behaviour in the classroom. Likewise teachers who did make efforts ran into trouble with management in some schools for disrupting 'harmony' and encountered pushback from pupils and their parents to 'mind their own business'.

There is substantial research on girls' educational decision making, including the impact of gender norms and the difficulty they have converting academic success to economic success (Okano and Tsuchiya 1999). Nakanishi's (1993) ground-breaking work on 'gender tracks' finds that schools sort their female students into different 'life courses' by non-meritocratic factors such as gender roles, ones that the girls themselves internalise. However, until this thesis there has been no research looking into this process from teachers' perspectives, and how this might affect their desire (and ability) to act.

3.2 The Story of Equality and Egalitarianism in Japan

What equality and fairness mean in the Japanese educational context is of central importance to this thesis; and critical to understanding teachers' responses. This section will look at how two – sometimes contradictory – versions of equality (egalitarianism, and meritocracy) have been a political battleground, and come to be cornerstones of the Japanese education.

First, a brief note on how school works for a Japanese pupil, and what equality means as they move through the system. Indeed, in the past Japan's system has been cited as proof that education can be used to create an equal society (Cummings 1980). However, it has also been argued that while Japanese elementary and middle schools largely embody these ideas, the fierce competition for high school and university entrance is where that ends. The result is the relatively egalitarian earlier years descend into a ferociously meritocratic stratification of students, notionally purely by ability, but with an end result of sorting additionally by wealth and social class (Rohlen 1983; Kariya 2013a). Cummings and Rohlen (p317) both paint a picture of early education as egalitarian, an atmosphere which is subsequently destroyed by the "dark engine" of entrance exams for university. Much of the freedom from early years is lost in the haste to prepare for these exams, and the standardised and seemingly irrelevant fact-cramming became a point of contention. A pupil's finances become increasingly important as richer parents begin to invest in the academic arms race.

Where teachers are located chronologically in the school system (i.e. middle, high school etc) has implications for how they view gender differences in the classroom and affect what and when they notice things.

3.2.1 History of 'Egalitarianism' In Japan

'Egalitarianism' has been front and centre in Japanese discussions on education since the US occupation. However, what is not so clear is what this has *actually* meant as the precise definition varies by the group that is advocating for it.

It is most easily understood as a tension between the concepts of 'egalitarianism' and 'meritocracy' and a battle between conservatives and progressives. Traditionally, conservatives' version of egalitarianism is more about equal *access*, meaning that 'meritocratic' sorting by talent and/or ability is fair and desirable. Meanwhile, progressives focused on providing a uniform-quality education regardless of ability and mixing of children from diverse social and performance backgrounds (Cummings 1980; Okada 2012; Kariya and Rappleye 2020).

In the wake of World War II, Japan's education system was in the sights of the Occupation's (SCAP) democratisation reform efforts. To counter nationalistic and militaristic influences of the previous decades, the Occupation installed a new, egalitarian interpretation of 'equality of opportunity'. Its goal was social justice and individual enrichment, rather than to provide the right workers to provide economic efficiency. Compulsory education now included middle school which raised the leaving age to 15, a single '6-3-3-4' system was established in place of the multi-tiered school types, and sex segregation was ended (Okada, 2012, p. 34) .

From the moment Occupation pushed for equality of education regardless of "race, creed, sex, social status, economic position, or family origin" (Kariya 2013b, p.160). Japanese Education officials pushed back, modifying language to make sure that equal educational opportunity did not mean ensuring children were provided an identical education, but that children should receive an education that matches their "natural talents and individualities" (Okada 2012, p.49). What exactly constituted 'equality of opportunity' became a tug-of-war between conservatives and progressives. As soon as the US Occupation left, the conservatives began to push back even harder on their reforms in what became known as the 'reverse course' (Okada 2012; Kariya and Rappleye 2020).

Although conservatives were part of a broad consensus agreeing that clever, hard-working children should not be prevented from success for financial reasons – such as not being able to afford school – they also wanted to return to a pre-war system of school-level tracking, to filter out the next generation of 'elites' in the way they always had done before the interference of the

Americans. Efforts to turn back the clock met with fierce opposition from the newly re-formed teachers' unions – who had been banned before the war and were ready to be a thorn in the government's side in order to protect the egalitarian Occupation reforms (Okada 2012).

Progressives, including the teaching unions, felt a conservative ideal of 'egalitarianism' (meritocracy, differentiated schools by ability etc) was inherently inegalitarian as they provided different educations to different groups of students, there was no way to make vocational and academic schools equally respected, and because entry to these schools was largely determined by a child's social background (Kariya 2013a, p.63-67). They were particularly vocal about ability streaming which they saw as a 'self-fulfilling prophecy' whereby children would be sorted into a vocational school and feel that they were inferior, and that that feeling would impact them throughout life (Okada 2012, p.70).

From this point, treating children differently based on their academic performance, including ability streaming, would be contentious in educational circles. Kariya (2013a, p. 57) explains that the very idea became deeply associated with ideas of discrimination, and the idea that it was an 'evil' to be avoided had been elevated to the status of 'common sense' from the 1960s onwards.

However, the government – buoyed by the growing economy and aware of its need for high quality human capital – helped usher in the 'Ability Principle' which stressed the idea of merit and academic ability. It even tried to introduce National Testing. The Minister for Education stated that, although equal education was important, not everyone had to have the *same* education and that vocational schools might be better for some children "because of their family circumstances". The egalitarian efforts ideals espoused by the Occupation that the Unions fought so hard for was often decried as 'over-egalitarianism' (Okano and Tsuchiya 1999, p.41; Okada 2012, p.86)

This was foiled due to a coalition, including teachers and parents, forming to push back on the conservatives. They demanded a democratic education system, equal access for all, and came out strongly against the National Tests. Government reform attempts were dubbed 'discriminatory

education' and most schools refused to take part in the tests (Okano and Tsuchiya 1999, p.41; Okada 2012, p.91) . This is doubly important context for this thesis: firstly because here we see how strong an advocate groups of teachers have historically been in the fight for equality, and secondly because of the mechanism described here. We go into more detail in the section on problematisation, but it is important to note that here we have a coalition of actors (teachers and parents) identifying something they perceive as unfair and piling pressure on to get results.

In the process, however, came another development in progressive thoughts on education. The Teachers' union became averse to any thinking that linked social class background and achievement, even discussing whether a poor child might be at a disadvantage – even in an 'equal' education system – led to a "sense of discrimination" and was therefore 'taboo' (Kariya 2013a, p.75). This is one of the central messages of this section: the fight between conservatives and progressives over the concept (and therefore practice) of what it meant to have an egalitarian education system actually managed to push the issue of social class into the background for years. The government did not want to examine the idea that poor children might be disadvantaged by their circumstances and therefore not achieve the 'ability' standards they set – to them it was sufficient if they did not let a poor child slip through the net through lack of resources, but they still had to actually get the grades to be helped in this way. Meanwhile, the progressives in their effort to avoid giving any child a 'feeling of inferiority' (even to the point that some schools refused to give out marks) refused to mention social class for fear of reifying it. Kariya (2013a, p.75) explains that this played out against a backdrop of growing prosperity that further weakened the urgency to discuss social class.

3.2.2 Gender and Equality

The lack of debate on social class issues, and the mechanisms that led up to it, which is vital for this thesis. Class issues attracted little attention from the general public and did not feature in education debates for the aforementioned reasons. This 'disappearing' of demographic issues like social class will be seen throughout this thesis, and history does indeed seem to be repeating

itself with gender instead – albeit with modifications we will cover in detail in the latter half of this dissertation.

As cannot have escaped readers' notice, the discussion thus far has concentrated on social class, rather than sex. In fact, despite the international attention paid to Japan's equal education system, gender has generally only received a page or two in the seminal books on the subject such as Cummings (1980) and Rohlen (1983). Although, largely thanks to the efforts of scholars such as Kariya, social class has been dragged back under the microscope this has not happened with gender – even though sex was listed as far back as the original wording of the Occupation law for educational equality.

This is potentially partly due to similar aversions to discussing and reifying gender: Hazama and Senuma (1993) posit that during the post-war period there was a shift away from an explicit bias favouring boys to an implicit one – this thesis will discuss the resulting dearth of public discourse and how it leaves most people (including teachers) in the dark about gender issues in Chapter 8. Although not specific to mathematics and studying the earlier primary educational stage, Cave (2007) found teachers reluctant to bring up gender issues; they asserted that they treated children the same. Despite this, they viewed their students depending on their sex and viewed girls as hard to handle due to their social relationships. Likewise, Japanese researchers such as Kimura (2009, 2010) have found significant barriers in 'teacher culture' to the design and implementation of gender-neutral or gender-sensitive education. This thesis probes directly at these conundrums.

Tracing the history of feminist research tracking gender in education, one comes up against another problem: the societal backlash of the early 2000s. As the movement picked up traction, it also attracted "organised…political and educational" backlash, and the effect still lingers (Yamaguchi 2007, p.591; Miyazaki 2018). Miyazaki (2018, p. 9) documents how researchers such as Amano (1988) were urging a shift towards 'equality of outcome' research, as it was comparatively more difficult to identify educational inequalities compared to the starkly visible

ones in the home or the workplace. An 'illusion of equality', Amano posits, and a focus on meritocratic evaluation on grades means that it is easy to dismiss disparate outcomes as women's choices. However, the backlash was on its way: Miyazaki (2018, p. 14) points out that while something similar occurred internationally (see literature on the 'boy turn' in the UK (Weaver-Hightower 2003)) it was generally triggered by girls catching up (or even overtaking) boys academically, however this was not the case in Japan - the backlash was "not against actual changes in educational achievement" but because of a challenge to gender roles.

Another important piece of context that we touch upon during the rationale for this research, but which bears repeating here, is that researchers looking at women's education have noted that there has always been a fairly weak link between girls' success at school and the world of work (Brinton 1993; Okano & Tsuchiya, 1999). Enough that girls (and their parents) will have to make rational decisions to maximise their chances in life. Okano and Tsuchiya (1999, p. 74) go as far as to say, "the meritocratic nature of educational participation in contemporary Japan applies only to the male half of the population". Rohlen, author of one of the seminal texts on equality in the Japanese education system, stated that gender segregation is a "significant structural aspect of Japanese schooling" and that while "the official curriculum and entrance procedures provide for strict formal equality of opportunity…parental attitudes, informal patterns of interaction at school and the marked sex differentiation of adult roles all contribute to very different results for boys and girls…girls, and their parents for them, choose different futures" (Rohlen 1983, p.309).

Before we can move on, there is one more important development in educational ideals that must be examined: *yutori kyoiku*.

3.2.3 'Relaxed' Education and Individualisation

When the 'catch-up' era that characterised the post-war period was deemed to be over and Japan had achieved what it wanted, there was a renewed desire to change things up to meet the demands of a new, competitive global situation. The Japanese education system came under fire

as being too highly pressured, too narrowly focused on memorising facts, and blamed for not inculcating the creativity and innovation that would become so highly prized. The antidote was a series of reforms dubbed *yutori kyoiku* or 'relaxed' education (Okada 2012; Cave 2016; Kariya 2018). Some of the hallmarks of the reforms were reduced class hours (including a shorter school week), experimental teaching methods, and – crucially for this thesis – an ideal inspired by western concepts of individualisation: 'individualised learning' and 'individualisation' of teaching (Fujita 2010; Kariya 2018).

The reforms themselves have had a mixed reception. The *yutori* reforms were partly a response to the critiques of credentialism which had pervaded Japanese education over the preceding decades: the extreme stress and pressure of 'exam hell' which determined children's future success using a single snapshot of academic performance, had become problematised by society (Rohlen 1983; Ishida 1993; Kariya 2010, p.88). Despite the reforms seemingly answering what people wanted – reducing the pressure on children – many parents were horrified at the watered-down curriculum and pulled their children from the public education system in a form of 'bright flight'(Kariya 2018, p.18). Meanwhile, the children that remained started to suffer from the effects of an 'incentive divide' (Kariya 2013a): with lowered standards, a new emphasis on children being able to self-motivate their study, and even tweaked university admissions criteria, there was enough wiggle room that children from poorer backgrounds began to suffer – once individualisation and creativity were prioritised the individual advantages and disadvantages of children's home life began to have an effect. Although credentialism and the effects of the *yutori* reforms are usually discussed in the context of social class issues, in this thesis we will see its legacy as it pertains to gender.

As we touched on in the section on teachers' power, reform efforts were actually significantly hampered by a lack of buy-in from teachers. Teachers were not on board with the changes they had to make, and the gulf between policymakers and practitioners cannot have been helped by

the fact that there was only a single teacher on the commission (Kariya 2013a, p.167; Cave 2016, p.225).

Although the *yutori* reforms were walked back to an extent, they do seem to have left an indelible mark on teaching culture by encouraging teachers to prioritise regarding their pupils as individuals – something that we will explore in detail as we move through the results of this research.

3.2.4 Section Summary

The concept of what it means to have an 'egalitarian' education system has been under discussion since the postwar years when equal education (regardless of sex, and other characteristics) was guaranteed by the 1947 "Fundamental Law of Education" Kariya (2013b, p.160). A centralised curriculum, uniform teaching standards, and unintentionally efficient resource allocation helped to create a more egalitarian system of education.

Equally, there have been concerns about inequality – especially feelings of inferiority in vocational and part-time students, and there is a longstanding aversion to ability streaming. The fighting between conservatives and progressives over the meaning of 'egalitarian education' helped to chase discussions of demographic inequalities into the shadows (Kariya, 2013a p63, 2018; Okada, 2012).

School years are often viewed as being relatively sheltered from the impact of the highly gender segregated outside world. This is largely because Japanese schools (especially elementary and middle) have few institutionalised sex differences – those that do exist are usually in sports, uniforms and forms of address. However, research suggests both that there are gender differences, and that teachers interpret their male and female pupils' attitudes and actions differently. Researchers have also noticed stark inequalities in the education system, seemingly part of the fabric of how the education system operates inside the gendered world (Okano & Tsuchiya, 1999; Rohlen, 1983: Brinton 1993).

The competing definitions of equality (of opportunity? Outcome? Meritocracy?), the squeamishness around addressing the impact of demographic characteristic like gender, and the legacy of both the egalitarian ideals and the individualised approach of the *yutori* reforms will be invaluable for understanding how teachers view gender differences, and how they interpret them (or not) as problems.

3.3 Problematisation

In this section we examine the literature on problematisation, before considering examples of past problematisation of educational and gender issues in the Japanese context. We then propose a new model of non-problematisation for this thesis based on synthesising these examples. The research questions of this thesis include exploring the mechanisms contributing to teachers' perceptions and how they impact the (non)problematisation of this issue. This section particularly deals with ways we will evaluate findings for this latter question.

3.3.1 Problematisation Theory

Problematisation theory is the cornerstone of my analysis for the latter questions on 'why' – "why is there a low level of problematisation of the mathematics gender gap in Japan?", and "what sorts of mechanisms and barriers are preventing it from becoming problematised". Conditions only become problems once they are problematised, that is, understood as *being* a problem. Inversely, arguably non-existent conditions can become problems if they are problematised. Problematisation is therefore depends on the regarding of a condition (real or imagined) as a problem.

Research into problematisation, particularly of topics affecting young people, has a strong history in Japanese studies. Scholars such as Kitsuse (Kitsuse and Spector 1973; Kitsuse et al. 1984) led the way with new approaches to problematisation through research into the *kikokushijo* phenomenon; he and his co-authors advocated for a symbolic interactionist *cum* social constructionist approach to how things become problematised.

First, we must establish what a social problem actually is. Hilgartner and Bosk (1988, p.53) described social problems as "projections of collective sentiments rather than simple mirrors of objective conditions". The strength of this approach, and of paramount importance to this research, is that it allows that some things can become problematised while others – even while being arguably as serious or with similar conditions – are not.

Prior to this version of problematisation put forward by researchers like Kitsuse, social issues used to be seen from a functionalist perspective. Social problems were dysfunctions or 'social pathologies'. In the functionalist, Durkheimian, consensus view of society, social problems are those things which interfere with the favourable running of the society and obstruct its goals. This view assumes that there is an 'equilibrium' that society naturally tries to find, and that social problems research is then about identifying those conditions that throw out this equilibrium and finding out what is causing them (Spector and Kitsuse 2001; Toivonen and Imoto 2012, p.6).

However, this approach allows little room for the possibility that societies can change over time, or that society might be reacting to something that is not a 'real' problem, or *not* reacting to something that is. The functionalist approach often compares society to a body, and problems to a sickness that the society/body then tries to eliminate. However, if we extend the metaphor a little, hay fever is an example of the body reacting to a benign substance as if it were an actual threat (in the process it ends up creating something close to a 'sickness') and there are many more dangerous diseases that are asymptomatic. If we take this view to discuss the gender gaps, this 'sickness' could be quietly eating away, unnoticed, at potential future economic boosts and keeping women out of participating in a lucrative and dynamic set of industries. Or a lack of societal problematisation could mean that there is not anything wrong. It is therefore, I believe, more useful for this topic to test for problematisation by seeing whether it is actually considered a problem by important actors.

What makes something a social problem? Rather than a collection of *objectively* undesirable/deviant conditions, under a social constructionist view problems are instead the

product of people *asserting* that objective conditions exist and then defining them as being a problem (Spector and Kitsuse, 2001). In what is dubbed the 'claims-making process', concerned parties will point to something that they consider unfair or harmful, and then demand action be taken to fix it. After this demand is made, all parties (i.e. media, government etc) who get involved become part of the definition of something as a social problem (or not) (Spector and Kitsuse 2001, p.73). Fundamentally this process is a relational one between two or more parties; sets of activities of claiming a problem exists and demanding action. For this approach, what matters about 'objective conditions' is what people believe and say about them, not whether they are 'real' or not.

According to this theory, the focus should be on the 'claims-making process' by individuals/groups engaged in activism on a particular social problem rather than on evaluating whether there is really an objective condition that is triggering it. Sociologists who want to understand social problems should, therefore, not be in the business of ascertaining whether those claims are 'accurate'. Spector and Kitsuse (2001) point out that it is difficult to justify taking the sociologist's views on 'what is important' more seriously than those of the people they are studying, and that verifying claims is out of the remit of sociologists either way (with their example being checking whether a river is actually polluted or not).

Over the years this has come under fire for being overly simplistic. Thibodeaux's (2014, p.834) analysis shows that research into social problems using social constructionist approaches generally cannot rule out objective conditions as being "causal variables" for social problems, and that much research that uses the approach does actually fall back on looking at the validity of the claims.

In my case, my first research question is geared around ascertaining whether the 'putative conditions' of gender differences (such as those reported in PISA) are something that teachers recognise or not. I am not trying to establish whether the PISA tests are 'real', but only if they are real to teachers in Japan; the answers to that question hugely inform the answers to my second.

If the kinds of gender differences reported by PISA (and other sources) are not recognised in Japan then it follows that there would not be any problematisation and the question is therefore moot.

In essence, I am pitting the claims-making of select researchers/testing bodies against Japanese teachers' perceptions. Upon discovering that the gender gaps are recognised but not problematised when they might be problematised elsewhere (such as the UK), the question then becomes 'why?' If teachers do recognise some, or many, of the conditions reported by previous research I am then investigating a gap between recognition of these (on a latent level) and a lack of corresponding societal problematisation.

I want to take a balanced approach. Rather than a hard-line social constructionist approach where the only things that matter are what is claimed/believed, or a hard-line functionalist approach where the only thing that matters is whether the conditions are 'real'. In the previous chapter we spent time establishing that the sort of gender gaps in mathematics reported in PISA can be assumed to exist – at least for the purpose of using them as a tool to explore how teachers feel about gender differences between boys and girls in mathematics more broadly. In the next sections we will look at some examples of problematisation in the Japanese context.

3.3.2 Japanese Cases of Problematisation

Researchers have applied problematisation theories to various topics in Japanese studies. One of the most prominent areas is 'Youth Problems'. Staying with this research's twin themes of educational equality and gender we will look at two prominent examples of this research: *kikokushijo* (returnees) and schoolgirl prostitution. From these two examples we will be able to synthesise a new model for (non)problematisation for this research.

3.3.2.1 Kikokushijo

The story of *kikokushijo* is of the disadvantage of a group of children within the Japanese education system. *Kikokushijo* are children who have returned to Japan following time spent abroad with their parents who have been posted overseas. How the circumstances of this

relatively small group of young people became a problem considered worthy of national attention and policy changes reveals a lot about problematisation in Japan in the context of education.

The basic claim (of the 'claims-making process') was that *kikokushijo* children were disadvantaged in the competitive, exam-focused system of university entrance after spending time out of the Japanese school system. As we established in the previous chapter, not only was this route considered the only one to success, but that schools (particularly in the later stages such as high school) tended to pivot their activities specifically towards preparing students for this process. This claim (and the problem in general) got off the ground largely because of two factors. The first is that groups of parents organised and pointed to these conditions that they perceived as being unfair. It is worth noting that these parents (evidenced by the fact that they had been posted overseas in the first place) were often rich, powerful, and well-connected. The second is that this issue was raised in a time when society was receptive to it (Kitsuse et al. 1984; Goodman 2012). We will examine both in turn.

One of the most striking characteristics of this issue's problematisation is who enabled the process to start; it was concerned *parents* of *kikokushijo* who were the ones that kicked off public debate. It was parents who demanded the government investigate and rectify their children's disadvantages, and later many of them contributed to public awareness and interest through going on to do research on *kikokushijo* as part of the academic/expert 'industry' that tends to spring up around issues as they gain traction. Parents played a huge role in creating a sympathetic image of their children as worthy of pity and help, and it worked: the plight of this small group caught the public imagination. The government responded by agreeing with parents and delivering solutions. Specialist schools overseas, reintroduction schemes, and university quotas were amongst the changes. Goodman (2012, p.34) comments that "no other group…has ever been provided with such 'positive discrimination' for university" (Kitsuse et al. 1984; Goodman 2012).

The sense of injustice is a key factor in how this issue gained traction. For context, at this stage in the 1970s, futures were (even more strongly) tied to university graduation and the tests to get in to these were highly standardised, high stakes and seen as the sole route to success – the fact that this was inaccessible to *kikokushijo* was intolerable to them and their parents (Kitsuse et al. 1984).

Another important factor to this problematisation was that the issue was raised against a larger background of discussion about what it meant to be Japanese (Goodman 2012, p.35). The widespread assumption at the time was that the uniquely complex nature of Japanese society meant that children who spent time abroad were doomed to never fit in. At the same time, anxious discussions about the brutally competitive examination system were also taking place. These conditions meant that the initial claims from parents that their children were a) disadvantaged under this system and b) that it would have serious consequences for their future, were a relatively easy sell. In the end it turned out that many of the difficulties that *kikokushijo* faced were "overstated", particularly as the measures to help them actually kicked in (Goodman 2012, p.36). In fact, it worked so well that they became a new set of new social elites, which is rather unsurprising when you consider who their parents are likely to have been.

As mentioned, when social problems begin to pick up traction, they often have a corresponding 'industry' of experts that produce research and solutions. A large body of research, opinion pieces, and popular books are usually a good indication that an issue is being taken seriously. For *kikokushijo,* this meant large number of researchers listing them as one of their primary research interests, and bookshops with dedicated *kikokushijo* sections for the public to enjoy. Parents were often the researchers and writers, and that level of investment and power is also likely a factor in how effective their demands were (Goodman 2012, p.34).

Another important factor is that the parents were able to harness the zeitgeist as it shifted. By the 1980s, Japan was firmly established as a major economic player on the world stage, and public discussion shifted to how to internationalise the economy. Even as the *kikokushijo*'s 'poor

things' image started to fall away, parents were able to reposition their children as potential leaders in this process of internationalisation. If the societal focus when the *kikokushijo* issue was first raised was about how they would fit into a Japan concerned with "modernisation [valuing] conformity, homogeneity, and loyalty" then it became about internationalisation where the order of the day was "heterogeneity, creativity, and individuality" - *Kikokushijo* went from being disruptive liabilities to being considered assets for exactly the same qualities (Goodman 2012, p 41). One question we come up against in this thesis is why there has been no similar attempt to harness the wider concerns over the workforce shortfall/the birthrate etc., against a political backdrop of 'womenomics' and growing interest in feminism, to position girls as potential economic saviours if they could be encouraged to go into STEM etc. in the way that these parents did with their *kikokushijo* children.

Business interests played an important part in this shift. At the time, there were concerns that the education system was not producing the sorts of workers needed as Japan faced a globalised world – they lacked creative and independent thinkers. Schools were also trying to position themselves as providing innovative teaching programs to attract new students: *kikokushijo* and those who wanted to emulate them were a new market (Goodman 2012). It seems possible that these types of changes could be applied to girls and mathematics, but we will look at why or why not over the course of this thesis.

If this example of *kikokushijo* shows a way that problematisation can occur in an educational fairness context, our next example looks at the other dynamic relevant to my research: gender issues.

3.3.2.2 Teenage Prostitution

Moral panic struck during the 1990s when schoolgirls were reported to be prostituting themselves *en-mass* for pocket money to buy designer handbags. Or so the story went. The reality, according to Kinsella (2012), was that the statistical evidence for this being a widespread

problem was actually extremely weak but that it had so captured the public imagination that it took on a life of its own regardless of these 'objective conditions'.

The media's role in problematisation is of particular importance to this thesis. The issue came to prominence (and problematisation) through a flow of information upwards through a "media hierarchy". Starting with teenage lifestyle magazines and pornographic magazines, the information was then picked up by more respected newspapers and news channels; having drawn national attention by this point the final stage was NGO and government research (Kinsella 2012, p.75). It was the public debate that ensued (and equally notable, the foreign media scrutiny) about the issue of teenage prostitution which prompted the government to implement new legal controls over selling underage sex – though there was always disagreement over whether punishment should be focused on the girls themselves or the adults soliciting them. As an example of the 'industry' that grows up around issues as they are problematised, the police begun collecting and publishing their own investigations and feminist researchers (amongst others) waded into the discussion – arguing about the causes of the teen prostitution problem and what should be done (including tightening restrictions or seeing them as the result of restriction of female sexual autonomy itself) (Kinsella 2012, p.68).

One of the differences between the *kikokushijo* situation and the teenage girls allegedly prostituting themselves is subjects' own role in the problematisation process. Whereas the *kikokushijo* had been largely passive subjects (talked *about*, not talked *to*) in their problematisation, teenage girls themselves participated in fanning the flames of public outrage and concern. Savvy girls treated dealing with the media feeding frenzy as a part-time job, where journalists would pay them for interviews and the girls would tell them what they wanted to hear. Particular horror was reserved for the girls who reported that they voluntarily, knowingly, and 'cheerfully' participated in prostitution for the financial gain – whether this was a common attitude, or even whether it was true or not, was found less interesting by the public than this sensationalist idea (Kinsella 2012, p.70). Kinsella posits that the fact that 'nice, middle class' girls

were also engaging in teenage prostitution, rather than just the 'usual suspects' from disadvantaged backgrounds was a factor in how seriously this was taken. The agency of young women will play a major role in my research, and from examples like this it is clear that subjects' autonomy can make a difference to how and what is problematised.

Statistics played a big part in the problematisation process, even when they were totally unrealistic. Kinsella (2012, p.73) notes that if the oft quoted statistic of 3.4% of girls prostituting themselves would actually mean that the numbers were "the equivalent of a small city". She also found that the Police statistics that recorded girls saying that they voluntarily prostituted themselves, and did so for the money, attracted a lot of attention. This is important for us considering the extremely detailed statistics that organisations like PISA and the World Economic Forum produce about the gender gaps in mathematics and the sorts of economic conditions produced by them – such as the $550 billion estimated lost due to gender inequality in Japan.

Like the previous example of *kikokushijo*, the timing of this social problem coincided with wider societal debate which meant society was receptive to the discussion. The late 1990s are described by Kinsella (2012, p.57) as a time where there were "cultural anxieties about shifts in the balance of power between men and women". There were concerns abounding of women 'abandoning duties' and 'detaching' from mainstream Japanese society, a kind of public anxiety over deviance from traditional gender roles. Kinsella also notes that a concern over independent, sexually aggressive, materialistic women turning away from traditional and acceptable life courses was a parallel to the contemporary concerns over emasculated men hiding in their rooms bingeing on anime (*hikikomori* and *otaku*) or unable/unwilling to be proper male breadwinners (NEETs).

Again, the academic research was an important part of the industry surrounding the teenage prostitution issue. Kinsella (2012, p.75) describes the works as instrumental in "escalating and validating media discourse" and academic research became a major part of "unearthing, expanding, and validating social narratives". As we have seen, the lack of academic research in

this area – potentially down to the feminist backlash destroying momentum for this kind of investigation – is likely to be a factor in the non-problematisation we will see in the later chapters of this thesis.

3.3.2.3 Other Routes to Problematisation

These cases focus on how and why issues *do* become problems, the subsequent 'life-cycle' of the claims-making process, and the attention and solutions that result from this process. Although there is no single recipe for problematisation in Japan, we can see some congruities between the examples presented in this section. The public imagination needed to be caught, which could be from:

a) a powerful group (especially parents) advocating on behalf of the wronged/'deviant' group

b) through media dissemination of the topic to the wider public.

Further, the timing with which they were raised had to coincide with broader societal debates and anxieties; the social problems in these two examples were indeed raised at a time of wider cultural discussions, values, and anxieties related to them. And, in a call back to older functionalist versions of social problems (i.e., deviance), it was about so-called 'deviant' or undesirable conditions such as unfair disadvantage in an academic sphere, or girls going off the prescribed societal rails and indulging in unacceptable, unladylike behaviour by the standards of the day.

We could simply assume that educational issues related to gender are not problematised in Japan, or that Japanese society is specifically indifferent to girls' unequal experiences in STEM. However, the evidence does suggest otherwise. In the summer of 2018, Tokyo Medical University was embroiled in scandal; the university had been caught systematically rigging entrance exam scores to keep the number of successful female applicants below 30% (JapanTimes 2018). This came to light due to an ongoing investigation into bribery, but once this aspect of corruption was discovered it drew widespread attention and condemnation. The consensus, through widespread

reporting in both Japanese and foreign media, was that this was both unacceptable and unfair. According to sources, the policy had been put in place to increase the number of male doctors as female doctors will quit the workforce after marriage and children. Punishment was swift, subsidies were taken away and the principal was eventually replaced with a woman. However, several female doctors were quoted in media reports saying they had brought this issue up in the past, including at government committee meetings, but there had not been much interest. In this case it was an explosion of anger in the press, and particularly online on social media sites such as Yahoo and Twitter, that dragged the issue to the government's door (BBC 2018). A few years previously, a politician glibly questioned what the point was of teaching girls mathematics; functions like sine and cosine were, in his view, not as useful or practical as teaching girls the names of flowers. Again, there was public outcry and he was forced to backtrack and issue an apology (Kimura, 2015). From these examples alone we can see that educational unfairness and sexism can indeed attract public attention in Japan.

We can see from the examples in this section that, in contradiction to Kitsuse and in agreement with Thibodeaux (2014), a certain amount of verification of the putative conditions is necessary. Knowing whether there *were* objective conditions behind them, and how serious they were was necessary to make evaluations of the public response. In some cases, they found that the putative conditions were exaggerated and the problematisation and societal reactions were arguably even disproportionate to the reality of the situation – particularly if there were numbers involved. For the purposes of this topic, we must also address situations where it is the other way around: when can ostensibly serious problems not become problematised?

The previous examples in this chapter showed how the government was prompted into action, but this was in response to demands made of them: whether directly by parents in the case of *kikokushijo* or indirectly through public pressure (at home and abroad) in the case of teenage prostitution. Is there another way to force the government's hand that does not rely on

powerful claims-making, and non-government groups pushing for action on an isolatable problem? Could the problematisation and change come from the government itself?

Next we will explore an example of where exactly this does happen and compare it to the model we are building for problematisation. Schoppa (2006) applied Hirschman's (1970) theory of Exit/Voice to socio-economic issues in Japan. Exit/Voice comes from the political and economic sphere and posits that pressure can be applied directly to the company (or government, in this case) using 'Voice', or indirectly via 'Exit'. The former is an organisational approach: groups form, make their dissatisfaction known, and demand action is taken or disruption will occur. In the two cases we have investigated so far we have seen the clear use of 'voice' being used to great effect; parents and PTA/NGO groups were the claims-making actors.

If 'Voice' is organised then 'Exit' is the opposite; it is indirect, uncoordinated, and taken by a mass of individuals rather than by groups per-se. The dissatisfied mass of individuals will simply vote with their feet; in a business context it is often left to the companies themselves to recognise the problem and work out what to do to solve it. Unfortunately, in terms of moving things towards a solution these two approaches of Exit/Voice are largely incompatible. A response is more readily come by from using one approach or the other. Exit affects the ability to use, and the effectiveness of voice: if people walk away then where is the critical mass of people to try and demand changes? (Hirschman 1970; Schoppa 2006).

Schoppa (2006) applies this theory to explore the policy responses, and lack of effective ones, to declining fertility in Japan. The difficulty of combining motherhood and a career, has had a (now well-documented) effect on late/non-marriage and the consequent decline in the birth rate (Schoppa 2006; Holloway 2010; Shirahase 2014). However, this link had not always been clear; cases like this show another path to problematisation where the advocating group (like parents in the previous examples) are not present. In many ways this process is the opposite to the previous examples: with no advocacy group women just walk away until the government notices the effect this is having.

Policymakers were slow to spot the declining birth rate, and slower still to work out the causes. It took decades of tracking statistics for them to finally recognise the decline was neither temporary nor the result of a statistical blip (Schoppa 2006, p.12). Instead, it was the aggregate result of Japanese women living their lives differently than their predecessors. Many women chose to opt-out of either work or childrearing. Women exiting via choosing not to have children (or to have fewer) put pressure on the government because of the implications for the future workforce. Through withdrawing their labour, even those women who chose (and who could afford) to forego working to be full-time stay at home mothers were able to apply indirect pressure to the government (Schoppa 2006).

However, as we touched upon earlier, this exit can interfere with the ability to use Voice. Women did not mobilise; they did not group together to demand changes to systems that force them to choose working or motherhood. By contrast, the parents of *kikokushijo* grouped together to point to the problems and demand solutions to them. There was no corresponding process for the children/career choice problem. As women chose to exit (i.e., 'opt out' of) the problem, rather than mobilise, it fell to "bureaucrats to interpret their behaviour, [and] figure out what to do" (Schoppa 2006, p.158). This slowed down the problematisation process, and it also consequently delayed the development of solutions. It made those policies that were developed a harder sell to politicians and businesses. The cause-effect was less clear without input from women; we have already seen in the section on teachers and education policy that implementation is much smoother with buy-in and input from the groups affected. Finally, those women who chose no exit strategy, who chose instead to struggle with both paths, were perhaps in even less a position to organise a political movement that would be able to campaign for change (Schoppa 2006).

As for industry and advocacy groups, opinions were divided on whether the birth-rate issue was actually a problem or not. Many prominent feminist thinkers at the time celebrated the decline in marriage and the number of children as being liberating for women. To them, women

choosing *not* to do these things was a victory over patriarchal culture and the political pressures of the past such as the pre-war pro-natalist policies (Shoppa 2006). Women's advocacy groups existed, and although these groups were very effective at mobilising for and getting what they wanted (i.e. food safety regulations) their membership tended to be housewives (who had chosen their exit path) and this set their objectives (Schoppa 2006, p.158).

The fact that there was not agreement on the issue as being a problem, inevitably, made problematisation difficult. This highlights one of the features of this case, as compared to the previous examples in this chapter, that will be highly relevant when it comes to the topic of this thesis.

Those examples were specific issues affecting a small subset of people. The exit of women and the birth rate is a *very* large-scale problem, with many interlocking issues impacting it, and it ultimately affects the entire population – even if it had only women would still have been a problem for 50%. Worse for the idea of mobilising, as we discussed during the literature review on feminism, women are not a monolithic group with identical interests. This is clear from Schoppa's example of the housewives associations, who had the political muscle but not the mandate or the desire to do something to improve things for all women – including those who had chosen to work instead.

A quote from feminist heavyweight and sociologist, Ueno Chizuko (Schoppa 2006, p.158), neatly summarises the problem.

> These women make very practical and realistic choices in the context of contemporary Japanese society…they are only doing what is reasonable given the limited options available to them. It is in fact that their lifestyle is so comfortable that makes them so unlikely to leave it or do anything that would unsettle it.

This can be described as a collective action problem, where people make rational choices for themselves even if it delays (or prevents) a solution from being found. Women's choices (i.e., their agency) are a large part of how issues can become problematised or not and whether there is mobilisation on a topic or not. It is clear that looking into problematisation of the gender gap in

mathematics, which bears more than a passing resemblance to the career/children dichotomy explored here, will need to take the effect of girls' choices on teachers' perceptions into account too.

3.3.3 Towards a New Model of (non)Problematisation

From the examples explored in our sections on problematisation we can see some clear patterns that occur, and from here we can sketch out the conditions that need to be met. In this section we present the model we will use during analysis of teacher interviews to uncover the mechanisms of non-problematisation of the gender gaps amongst Japanese mathematics teachers.

'Voice' – An organised process whereby governments were put under pressure from the outside to notice and address an issue. Successful problematisation.

- *Injustice/Unfairness*: The circumstances problematised were considered unfair to the subjects of the complaint.
- *Choice/Subject's Agency*: Related to above, things were unfair because they violated the subjects' choices. Alternatively, making the 'wrong' choice was also problematised.
- *Powerful claims-making actors:* parties invested in the plight/transgression of the subjects organised together to make their feelings known and press on those responsible for chance – either for increasing awareness or directly onto policymakers
- *Societal benefit for resolving issue:* social or economic benefits (i.e., creative, international *kikokushijo*) restoring social gender norms (girls not engaging in prostitution, however voluntary – perhaps especially voluntary).
- *Zeitgeist:* raised at a time when there was wider interest/concern connected to the issue. Captured public imagination or answered a public anxiety.

- *Moral Outrage/Gender roles being broken:* conditions violated educational norms such as fairness (equal competition in education in a 'degreeocracy') or gender norms such as girls being 'good', sexually pure, and less independent.
- *Media attention:* a driver of wider public recognition and resulting discourse. This raises awareness, frames narratives, and sets the tone.
- *'Industry' and activist involvement:* experts, activists, and businesses responding to the perceived issue to add their views and provide solutions.

'Exit' – A disorganised process whereby governments noticed a problem and attempted to address it. Government felt pressure from the exit numbers and responded. Mixed results for problematisation.

- *Economically/(socially) undesirable results of issue problematised:* the by-products of the issue are noticed and problematised first, then the process moves to problematising the issue itself. Perceived threats to the social fabric and future economic viability (such as the dearth of workers forecast due to falling birth-rates). Best if, as with *kikokushijo*, business can get on board with it being a necessity to fix.
- *Challenge to gender roles*: women behaving in ways counter to traditional norms of femininity (refusing motherhood, not only working in jobs in complementary ways to men – i.e., part time 'release valve')

Issues this strategy faced:

- *Subjects 'exit' or opt-out, hindering 'voice' and mobilisation:* instead of the powerful claims-makers in the 'voice' style of problematisation, women individually opted out of the problem which made it harder to group together and press for a solution.
- *Disagreement over whether it is a 'problem' (related to Choice/Agency, and Injustice above):* far from universal agreement, including from important groups of (those who could/would have been) claims makers, such as feminists. Women continued to vote with their feet regardless of consensus.

- *Large scale problem affecting broad, disparate group of subjects:* broad spectrum of people affected, rather than a small group who are easily identified and 'othered'.

3.4 Conclusion

In this chapter, we have situated this thesis within the current research in this (and other closely related) field and discussed the major elements of the literature we will need to draw upon to understand teachers' responses to the gender gaps in mathematics. This chapter ends by summarising the key points highlighted in these sections and that will play a core role in interpreting interviewees' answers.

The literature we have reviewed strongly suggests that teachers view girls and boys differently and interpret their successes and failures in different ways. Although this research is predominantly circa 30 years old and not connected to Japan, we do have some hints that this could hold true for Japan as well, namely that perceptions of mathematics as a subject itself are highly gendered in Japan too. We have also seen that these beliefs that teachers hold not only have the potential to affect how they treat their pupils (and therefore affect their outcomes), but also that the attitudes themselves can be transmitted to the students who then internalise them. In this section we also learnt that there is research by Japanese researchers on the difficulties of implementing gender neutral policies in schools, concluding that teacher culture and pressure from management and/or parents can make it hard for those teachers who try to put gender neutral teaching into practice. Finally, we also saw that there has been research in Japan on what underpins girls' decisions to choose certain life paths, but we have no research on how this affects teachers' perceptions.

In the second section of this chapter, we detailed the changing definitions of 'egalitarianism' in an education context – we saw how the proxy war between progressives and conservatives over what it meant to give children an equal education pushed demographic issues such as social class into the background of discussions until very recently. This section also indicates that there is some resistance to discussing gender issues in education, and that there was a significant

backlash against feminist educational research in the early 2000s which seems to have disrupted study in this area significantly. Finally, this section on equality and egalitarianism in Japanese education describes how a newer shift in educational norms caused by the controversial *yutori kyoiku* reforms brought in the idea of prioritising a child's individuality and to treat them *as* individuals. We will consider how both of these overarching norms – egalitarianism in various forms and individualisation – interact in the latter half of this thesis.

In the final section of this chapter, we went through the theory of problematisation in detail, starting with a top-level overview of how something can become problematised. We then explored two examples of successful problematisation concerning the themes of this research: education (*kikokushijo*) and gender (teenage prostitution/compensated dating). We saw the similarities and differences between the characteristics of these two cases and how they became problematised, such as: strong claims-making groups, media attention, a sense of unfairness, breaking social/gender norms etc. We then turned our attention to an example of problematisation with mixed success. We compared this different route to problematisation to our first set of cases to understand some of the pitfalls that can cause non-problematisation. This includes: a lack of consensus on whether an issue constitutes a problem, a non-coordinated response, and (potentially) the wrong people claims-making while the right people have opted out of having to deal with the issue entirely. Our conclusions here are used to build towards a new model of non-problematisation in the Japanese context and will be measured against the information we learn from teacher interviews.

In the next chapter we will go a step further to define the frameworks we will use to capture teachers' opinions and to understand the mechanisms of non-problematisation of the gender gaps in mathematics.

Chapter 4 - Methodology

Statistical evidence from international testing such as PISA and TIMSS, and smaller scale studies conducted specifically in Japan, highlight boys and girls as having different attitudes towards and attainment in mathematics. My research will investigate the issue qualitatively by gauging teachers' perceptions of the gender gap and flesh out the issue for policymakers. This thesis' research questions are: "Do Japanese teachers perceive gender gaps in mathematics and, if so, how?" and after establishing this, "What are the mechanisms underlying these perceptions, and which could be contributing to (non)problematisation?". The primary method of research to answer these questions is the use of semi-structured interviews with mathematics schoolteachers.

4.1 Epistemological Underpinnings

Overall, my main theoretical framework is a moderate take on the constructionist approach to problematisation. This is then supplemented with key theories from feminist literature such as the conundrum of autonomy within social constraints, and with explanatory educational frameworks such as self-efficacy. I apply this approach to investigate teachers' narratives: their perceptions of their students' attitudes and achievement because these are subjective interpretations of facts (rather than the facts themselves). This is because my goal is not to state that my findings are "the way things really are", or 'how the gender gap itself really functions', but instead to focus on understanding how teachers construct their perceptions and rationalise what they see – constructions that are heavily shaped by their individual values and by their socio-cultural context (Walliman 2006, p.39). Much previous research investigating gender and mathematics has, understandably, focused on either pupils themselves exclusively or on observing their interactions with teachers. I do not investigate pupil behaviour itself as I am not trying to find the causes of the gender gap, and I am not trying to verify whether teacher

perceptions are ‘accurate’, although I shall note when the teachers have access to the data, including when they use it to validate their positions or when doing so changed their minds.

My research is interpretivist, this meshes with the major philosophical branch in the social sciences which maintains that the complex social world humans inhabit needs different standards than the scientific model used in the natural sciences (Lazar 2004, p.8). This takes into account that social phenomena are constructed and endowed with meaning by their social actors, and allows me to investigate the process by which this is done by uncovering implicit/underlying meanings as well as taking into account what is literally said (Bryman 2012, p.33). This interpretive constructionist approach means paying attention to shared meanings held by those in a certain group; in this case teachers - I saw my main task as “synthesis[ing] understandings” from interviews with individuals who hold diverse perspectives on this issue in order to answer my research questions credibly (Rubin and Rubin 2005, p.29).

Teachers’ perceptions are personal interpretations of their environment, rather than documentation of the environment’s objective reality. However, these beliefs will inform what actions they take and are, therefore, extremely valuable to those looking to effect change, and to reveal more about Japanese understandings of egalitarianism.

As discussed in the previous chapter, the methods that I use in this thesis (namely semi-structured interviews) are consistent with what previous researchers have done with similar topics which aimed to capture how teachers think about various types of educational inequality. First, we shall consider the role that ‘agency’ has in interpreting teachers’ understanding of the gender gaps.

4.1.1 Agency vs Structure

Agency forms a central theme running through both major layers of rationalisation, depending on whose agency and whether it is foregrounded or in the background of teachers’ thinking. As Agency vs Structure research generally focuses on actions, whilst my research focuses

on perceptions, I am using a slightly modified (sociological) version of this idea. I argue that teachers' perceptions are also constrained by structure and affects their view of their own agency and therefore problematisation. Teachers' perceptions of girls' agency, and how they exercise this within structure, are also critical.

Taking this view is also fitting given that one of the main tensions within feminist research is the conflict between two schools of thought on choice and where they place their emphasis: agentic and structural. The former tends to prioritise the autonomy (and therefore agency) of the individual, and that this is more important than structural constraints. The latter view holds that structural constraints are the main influencer of choice, and an individual's capacity to *truly* make a free choice due to those constraints is questioned (Hughes 2002). As we shall see in later chapters, the choices that girls and boys make influence how teachers see gender gaps and have a knock-on impact on problematisation (or the lack of it). We can see the changing emphasis if we trace the history of feminist research in Japan. Miyazaki (2018) describes the transition from gender disparity research (which focuses more on how women's choices are structurally constrained) towards gender construction and notions of the hidden curriculum – more in the spirit of structuration theories of Giddens (1984), and emphasising girls' own role in the construction of their gender and their agency within these constraints. The degree of control that teachers perceive girls as having, and that they perceive themselves as having, is key to understanding both their recognition, and non-problematisation, of the gender gaps in mathematics.

The concept of rational choice is particularly important when we come to examine the second layer of teachers' perceptions. Within this theory, an individual will examine all the options they have open to them, using the information that they currently have, and then select the one that will benefit them the most – acting in their best self-interest to the best of their knowledge. This theory assumes that the complex social systems they operate in are made up of the results of individuals making choices that benefit them (individually) the most. For example, a woman might

choose to work part-time because she knows she will be primary caregivers for their children; she chooses to compromise on status and pay to gain flexibility (Hughes 2002). As touched upon in the literature review, Okano and Tsuchiya (1999) find multiple examples of this kind of thinking in their study on gender equality and education. Parents would often prefer to invest in their sons' education due to the higher rate of return, and girls themselves would plan future careers around the desired timing of marriage and children.

However, it is important to note that there are limits to the idea that individuals are always exercising their agency (within a structure) to maximise the benefits to them. Allen (2008) suggests that the theory cannot fully account for the so-called 'irrational' decisions made due to psychological factors and internalised gender roles. She also cautions that taking this perspective alone can feed into the idea that women are to blame for continuing inequality; and that society and its constraints are all a product of everyone's free choices as most concrete structural barriers have been lifted. We shall see these limits ourselves in the interviews with teachers.

If there is a risk of assuming that girls and women have more control and choice than they really do, there is also danger in going too far in the opposite direction. Studies that focused on schools purely as a reproduction site for gender inequality, that assume that all children are socialised in the same way, and where societal constraints decide the choices people can make (and downplay the 'wiggle room' that individuals have) have been "critiqued as being overly deterministic" (Hughes 2002, p.84; Jones 2005)

We shall see that which side of the 'agency' vs 'structure' theory reasoning teachers have more sympathy for will impact not only what they recognise as being a gendered difference in their pupils, but also whether or not they conceptualise this as a problem or not – especially whether or not it is a problem that they have any power or responsibility to resolve. Next, we shall examine a theory which helps to inform my interview schedule: self-efficacy theory.

4.1.2 Self-Efficacy Theory

In the previous chapter we touched upon the influence of self-efficacy on achievement in PISA, and some of the ways that the Japanese style of mathematics teaching is geared to instill this kind of confidence in pupils. Here we will examine the concept itself more closely.

Self-efficacy (SE) is one framework I use to help answer my first research question concerning what (or whether) teachers notice mathematics gender gaps and explore their perceptions of gender differences in their own classrooms. Bandura's theory of self-efficacy describes a particular type of self-confidence: the belief that you can perform actions correctly to accomplish a goal, with high levels determining perseverance after setbacks. This then impacts achievement. Pupils with high self-efficacy attribute failures to lack of effort, not to lack of ability. This creates beneficial learning outcomes as it centres the idea that changing approach (or simply trying again) will give you a fresh chance to succeed. Low SE individuals often blame any failures on lack of ability, with resulting blows to motivation and confidence (Bandura 1997).

SE is formed from three main sources: mastery experience is an individual's evaluation of their own past performance – evaluating an outcome as a success boosts SE and failure damages it. The next is vicarious learning, which comprises evaluations of peer performance and role models; this is especially influential if an individual is insecure or lacks personal experience of the task, or if the role model matches the pupil in a particular demographic (i.e., female teachers impact female pupils). The last major component is 'social persuasions' or social/environmental messages, such as stereotypes, which have an even greater impact on self-efficacy if filtered through important figures like parents or teachers (Bandura 1997; Pajares 2002; Pajares 2006; Usher and Pajares 2006)

Gender can affect how much SE a pupil has: boys tend to have more in traditionally masculine subjects, and girls in traditionally feminine ones. When it comes to mathematics, as a stereotypically masculine subject, girls have lower SE than boys and this affects their performance (Bandura 2006; Huang 2013). Gender also impacts how SE forms; girls' SE is influenced more by

social influences and messages from influential adults than by their own experiences (Usher and Pajares 2006, p.137). In other words, the opinions of others – whether society-wide or from adults such as parents and teachers – impacts girls' self-efficacy even more than their actual academic accomplishments do. Combining this with research that shows teachers can 'transmit' their own beliefs to their students, affecting how pupils stereotype subjects and their self-confidence, means that understanding teachers' perspectives is even more important for discovering how (or, if not, whether) the gender gap can be problematised and addressed.

There are two main reasons to use SE theory to help guide my interview schedule: its relation to mathematics achievement (including in PISA), and because characteristics of Japanese mathematics education align very closely with how to build this confidence in pupils, using the same methods found in self-efficacy theory. According to OECD analysis, self-efficacy differences explained more of the PISA gender gap than both social background and all the other self-beliefs combined – dropping the gap by over half from 18 to 8 (OECD 2013d, p.Table III.7.5b). As the PISA gap is both what sparked my initial interest in this topic, and is also a tool for helping me to explore Japanese teachers' views on mathematics and gender, SE is a helpful starting point for informing the 'what' questions asking for teachers' perceptions of their pupils' attitudes and behaviours. There is a long history of using SE in education research, as it seemingly explains a large part (around a quarter) of the variance in academic achievement (Pajares 2006, p.343).

Effect of self-beliefs on the gender gap in mathematics scores

	Original Gap	After adjusting for socio-demographic background	After adjusting for students' self-concept in mathematics	After adjusting for mathematics anxiety	After adjusting for students' self-efficacy in mathematics	After adjusting for all mathematics self-beliefs
Japan	18	21	13	17	8	9
OECD average	11	14	4	7	2	1
(OECD, 2013:Table7.5c)						

Many mechanisms embedded Japanese style mathematics education seem calculated to improve students' self-reliance, and tenacity (i.e., improve their SE) and deepen their mathematical thinking ability in the process. Traditional emphasis on hard work over innate ability, encouraging perseverance by only helping when pupils are very stuck, and the central teaching method of getting students to present solutions to the whole class all strongly resembles Pajares' (2006) recommendations for improving self-efficacy (Stigler and Hiebert 1999; Whitburn 2000; Cave 2007; Takahashi 2017). Equally, introducing unfamiliar problem-types to students, and encouraging them to develop solutions themselves using prior knowledge, is aligned with the skill for which PISA tries to capture: mathematical thinking ability. Japanese teachers must be watchful and responsive to pupil behaviours (which are informed by pupil attitudes) to use this teaching method effectively.

My aim in using self-efficacy theory is to help inform questions in my interview schedule, so as to probe teachers' perceptions of their own classrooms, understanding what things in particular they pick up about these influential behavioural and attitudinal differences between their male and female students. Considering both the literature presented here, and the impact it makes on PISA, if teachers do notice gender differences (particularly those affecting achievement), there is a good chance that it will be in areas that are affected by SE. How teachers interpret these differences, including what teachers perceive to be the causes of them, will be particularly important for understanding how teachers perceive and rationalise the gender achievement gap.

4.2 Methods

Teachers' perceptions of the gender gap, and the behaviours associated with it, are constructed through complex interplays between multiple factors; including interactions between teachers and students themselves, and with the wider societal environment (Seale 2004, p.38). My research questions lend themselves to a qualitative approach, and particularly to the use of

semi-structured interviews to investigate social phenomena (such as the gender gap) and the attitudes towards them (Walliman 2006, p.131).

4.2.1 Strengths and Weaknesses of Semi-Structured Interviews

As we saw in the first section of the literature review chapter, this approach of using semi-structured interviews has also been employed by researchers looking into similar kinds of educational gaps by investigating teacher views: either (like this one) comprising the whole of the study (Hamilton & Jones, 2016; Younger et al., 1999), or as part of a larger research project (Kato and Yoshida 2003). This is a common practice employed by researchers looking into mathematics teachers' perspectives on a wide range of issues (Philipp 2007). The advantage of using this particular qualitative method in this study is that it allowed me to access teachers' opinions on a deeper level than I could through other methods (such as surveys) used by studies with similar goals, such as Zhang et al (2013) or even Tatano and Tahara (2001). Although this method has the potential of sacrificing breadth for depth, I felt this was an appropriate trade-off for the richness of the interviews and the ability to build a rapport with interviewees – this alone led to more interviews and even to (informal) classroom observation and invites to conferences and lesson study groups. My main concern in trying to balance out this problem was to make sure I had as diverse a sample as possible.

4.2.2 Sampling

The kind of school, and the kinds of students within the classroom (socio-economic, ability, gender, etc.) may affect the context within which teachers construct their perceptions, and which attributes they may pick up on as relevant. Education cannot be perfectly standardised across the whole system, with schools running the gamut from highly competitive elite schools to those with children displaying challenging behavioural problems (Rohlen 1983). For schools at the top, (private or state) competition for entry is particularly fierce (and sensitive to socio-economic influences including the ability to attend expensive *juku* after-school tuition). Once inside, their

teaching can even include cutting-edge techniques due to partnership with affiliated universities' education departments (Holloway 2010; Kariya 2013a; Tsukuba University 2017).

Research suggests gender gaps in mathematics at the elementary school stage actually tend to favour girls, but that this reverses during middle school and intensifies as children move through the education system (Isa and Chinen 2014; NCES 2019). Additionally, the PISA tests focus on testing children at the end of their compulsory education. In Japan this means just as they enter high school. I wanted to see whether this shift during middle school might be reflected in teachers' views, so my research focuses predominantly on middle school mathematics teachers. I also interview high school teachers, and those who teach in schools which combine both stages.

I approached this qualitatively, the most appropriate method for capturing teachers' complex and subjective thoughts and feelings for this project. Diversity of interviewees is one way to add credibility to qualitative studies like this one (Rubin and Rubin 2005, p.67). Variables such as whether a school was public or private, the socioeconomic profile, single-sex vs co-ed, etc. may influence both what teachers would be exposed to in their own classrooms and how they would interpret what they saw (Auwarter and Aruguete 2008). Therefore, although this was not a quantitative project requiring a statistically representative sample, I wished to ensure that I would have perspectives from a diverse set of teachers. Interviewees were drawn from a wide range of schools, school types, and included teachers of both sexes and different age groups. I also conducted semi-structured interviews with other important figures such as researchers and government officials to gain a fuller picture of how the gender gap is perceived in Japan. Where pertinent, demographic information is included in text. Please see appendix I for a detailed list of teacher codes.

'Regular' middle and high schools, run by the local and prefectural boards of education respectively, comprise the largest section of the school system. They also have the most varied pupil composition in terms of socio-economic status and mathematical ability, and therefore

represented a middle ground to compare against the more unusual schools in my sample. However, my final selection of interviewees also included national (*kokuritsu*) schools and private schools of varying types.

Schools were predominantly located in Tokyo, with a few others in nearby prefectures (Saitama, Ibaraki). In some schools I was able to interview every mathematics teacher currently working, which allowed me to compare teachers' perceptions. I was also fortunate enough to be able to return to two schools during my second round of fieldwork (February/March 2018) and interview the new cohort of mathematics teachers. I also re-interviewed one teacher in each school who had stayed on and was able to see whether anything had changed since my last visit (January/February 2016) – this was especially interesting considering the new round of PISA results had been released a month or so before their interview.

Private schools tend to only have fee-paying in common and vary hugely depending on whether they are the top, elite schools – the 'best' schools in the country are private – or simply mediocre. These schools can also be single-sex or co-educational. National schools are affiliated with, and run by, top national universities and are often involved with experimental teaching. These universities even send their teacher-in-training students to these affiliated schools to learn the ropes. The schools tend to be elite institutions. Competition for entry to these schools is fierce and, aside from providing a high-quality education, they are also seen as tickets into the attached high schools and even universities.

Elite schools (of all types) may seem to be overrepresented in the sample at first. However, PISA consistently finds that the gender gaps in mathematics are wider at the top end of the achievement scale, and, likewise, achievement increases with socio-economic status (OECD 2013d, p.18,174; NCES 2019). Competitive entrance exams for entry into high-prestige middle schools are the first stage of the ability 'slicing' process in Japan, and these national schools are exactly where many of the most able students are likely to be found (Rohlen 1983). Additionally, as we have seen from previous sections on problematisation, it is the concerned and powerful

who have had the most scope to get problems noticed. Attention was paid to the plight of the *kikokushijo* largely because groups of well-connected parents were invested in their children's futures and organised to demand attention and change. The elite schools many of my interviewees are from are some of the most prestigious in Tokyo, and parents are very involved after investing so much (money and otherwise) in the education of their children. If there were ever going to be a group of parents who cause a fuss about their daughters' academic inequality, it might well be in these schools.

However, this large group of interviewees from elite institutions are balanced out by having many others who were based in the (by reputation) 'roughest' schools, in the most socioeconomically deprived wards in Tokyo. These schools were locally notorious, to the point where I was warned by both alumni and even the teachers themselves that concerned parents did their best to pull their children out of the school. The fear was of violence and other 'deviant' behaviours like underage pregnancy, joining gangs, and even drugs – I am unable to verify any of this, but I heard the rumours from a few different sources. In terms of school type and status, my sample included a sample of teachers from what I have categorised as: elite, mid-ranked, and poor-performing; and then private, public, and national schools.

As gender was the specific trait I was interested in, I was also careful to ensure I had a diverse sample of male and female teachers. The exact effects of single-sex education are still debated (Kim and Law 2011; Prendergast and Donoghue 2014), but, because schools' values are partially shaped by if (or how) they split children by sex, my sample included schools with a heritage of single-sex education. Additionally, a teacher's own sex seemed likely to impact their views, perhaps even their attitudes towards their subject which can be transmitted to their pupils (Beilock et al. 2010; Gunderson et al. 2012). Female mathematics teachers are outnumbered by their male colleagues[2], making up around 25% of the workforce at the middle school level. Happily, although not aiming to be statistically representative, my sample of teachers is 26%

[2] Approximated using tables 1 and 34 from MEXT (2018)

female. I strongly believed that seeing whether female teachers' perceptions differed from male teachers' views would be an invaluable part of my study. Additionally, it gave me a chance to ask female teachers about their own relationship with mathematics and how they felt that had been received in society. Including female voices is, of course, also considered to be a crucial step when investigating gender and feminist issues (Hesse-Biber and Yaiser 2004; Bryman 2012, p.492).

Finally, to better understand the wider context of how the mathematics gender gaps are perceived in society, I included interviews with mathematics education researchers, bureaucrats and those involved with either researching or delivering teacher training. Although not as numerous, these interviews present an opportunity to compare their broader-level perspective with the narrower (but deeper) view of the teachers who are 'on the ground'. Some of them also had prior teaching experience. As we have seen from Chapter 3, these groups are also all potential parts of the 'industry' that appears around social problems should they be problematised. I wanted to know what they thought of what I had found so far, whether they were surprised at any of the answers, and (especially) whether they could shed any light on why the issue of the gender gaps did not seem to be being discussed anywhere – what would need to be done to fix this situation?

4.2.3 Developing the Interview Schedule

My research questions were tackled using face-to-face, semi-structured interviews. Instead of a survey-like set of exact questions there are 'question areas' to act as a guide. This is consistent with the 'responsive interview method' suggested by Rubin and Rubin (2005, p.36). Topic areas do include some set questions to ensure specific issues were explored, and to improve comparability between interviews in the analysis stage. However, it was vital to use a format that left interviewees room to decide how to answer; this also does not compromise the ability to explore new avenues as they develop during the interview (Bryman, 2012:472). This was decided after this responsive style proved very successful during my MPhil research and took the

interviews in unexpected, and useful, directions which were then incorporated into the interview schedule.

Qualitative methods, especially semi-structured interviews (in contrast to using surveys, or quantitative methods) gave me the opportunity to be responsive and follow leads flexibly as they developed. Using an interpretive constructionist perspective also mandates this in order to allow me to get at the deeper, underlying construction of teachers' perceptions. Due to the prominence of teaching designed to promote it in pupils, and its influence on behaviour and attitudes (including on the gender gap in PISA), self-efficacy theory provided the starting point for informing my interview schedule. Without this theoretical framework my interview schedule risked being too general. However it was important to be conscious that it was a 'frame' to hang questions off, rather than a checklist of traits to ask about. In accordance with such responsive interview methods, questions were also modified and added throughout fieldwork in response to teachers' replies (Rubin and Rubin 2005; Bryman 2012, p.401).

As discussed earlier in this chapter, self-efficacy had been flagged by OECD analysts as particularly influential on the mathematics performance of children in Japan in the 2012 cycle, which focused specifically on mathematics, so much so that this factoid made it into their 'Key Findings' country report (OECD 2013a, p.7). Although they did not connect this to the gender gap in that document, the fact that they did highlight the fact that the achievement gap was much larger than the OECD average was enough for me to seek out whether or not there was a connection between these two sets of findings (OECD 2013a, p.2). My original intention upon finding this was to do the quantitative analysis myself. However, I was lucky that the calculation had already been done for me for Japan; my hunch was correct and self-efficacy did indeed seem to be the key to understanding how large the gender gap was and therefore my key to investigating what teachers knew and noticed about the gender gap (OECD 2013d, p.Table 7.5c). After reading up on what self-efficacy entailed (Bandura 1997; Bandura 1999; Pajares 2003), what impact it had (Watt et al. 2006; Jain and Dowson 2009; Hoffman 2010) , and how it was created

(Bandura 2006; Usher and Pajares 2006) I decided to use this as a starting point for building my interview schedule for the 'what' portion of the questions.

Question areas are divided into two major categories depending on their goal: understanding how the gender gap manifests itself (or does not) in the eyes of teachers in their own classrooms, and understanding how teachers think and feel about gender differences in mathematics in general. The questions in the former category are where self-efficacy theory and its related behaviours (such as assertiveness, and self-reliance) were most influential. This section also covers raw achievement differences. Instead of providing inspiration for the kinds of questions I wanted to ask (as it had for the first part of the questions), the PISA results were now used purely as a tool to investigate teachers views of mathematics and gender in general – not tethered purely to their own (current) classrooms. The latter category explores how individual teachers understand gender (and gender inequality) in mathematics more generally. The goal with these questions was to tease out the wider views and stereotype awareness amongst this influential group; what, in their view, did society think of this kind of gender inequality?

Question areas include**:**

<u>PART 1</u>

1. *A self-introduction by teachers*. Why they had become (particularly, mathematics) teachers –how long they had worked at the school and if they had worked anywhere else previously (other schools, different school stage, *juku*) etc. Teachers' own experiences and feelings with mathematics growing up.

2. *Perceptions of achievement and behavioural gender gaps in their own classroom*. Teachers were first asked whether they noticed any differences between boys and girls in their classrooms (it was left up to them whether they interpreted this as grades, behaviours, or other – if they picked one then the other would be my next question

When applicable, I asked about the gender ratio in their ability-streamed classes, and/or their *bunkei/rikei* streamed classes.

3. *Discussion of gender gaps*. Teachers were asked whether they had ever discussed gender with their colleagues. They were also asked about their experiences with teacher training – to what extent is student gender's impact discussed in teacher training, both formally in initial training and in lesson study groups, and in informal discussions with colleagues.

4. *Children's futures*. Had teachers ever heard or discussed pupils' future/career plans? Teachers were also asked about whether they had female colleagues, about the gender ratio of female teachers, and what they felt was the cause of this.

5. *Opinions on Streaming*. Teachers were asked about their feelings on ability streaming, regardless of whether their school used the system. They were also asked their views on single-sex education. Finally, they were also asked whether they would see themselves changing anything about the way they taught if their classes were *coincidently* single sex. If applicable, teachers were asked about their views of the *bunkei/rikei* system.

PART 2

6. *PISA Results.* Teachers' awareness of, and feelings towards, the PISA achievement gap. Teachers were told towards the end of the interviews that the original prompt for this research was the PISA 2012 data, told the raw score differential, and that it was much larger than the OECD average. After their initial reaction, teachers were asked to describe their feelings around, and hypothesises for, the existence of these gender gaps. This

section of questions also asked teachers' perspectives on the fact that the gender gap did not seem to be discussed in general in Japan, and why they thought this was the case.

7. *Closing the Gap(s).* Teachers were asked whether it would be possible to find a solution to the achievement gap, or not. Whether they felt it *should* be or needed to be fixed, and, if so, whose responsibility they thought it was to do so. They were asked for suggestions on how to close the gap. They were also asked specifically about methods of raising girls' interest and confidence in mathematics. Finally, teachers were asked for any final thoughts and encouraged to ask questions (which often produced more discussion) add anything they may have forgotten or held back on earlier on.

To avoid priming answers to questions surrounding differences between boys and girls in their own classroom, the sequencing of questions was also important. Leaving discussion of the gaps in the tests such as PISA, or societal stereotypes, until the end after teachers discussed their own classroom experiences was the easiest way to avoid biasing their recollections with 'statistics'; it also meant that the eventual reveal of these gaps often triggered a stronger reaction and even more discussion (Bryman 2012, p.474) – teachers were not informed of the PISA gap prior to the interview. Otherwise, the order of the questions varied depending on the flow of the conversation.

I had the advantage of conducting a pilot interview before the first round of my fieldwork. This interview took place at a Japanese-run school for Japanese children in Europe, following the official Japanese curriculum. This pilot's purpose was to allow me practical interview experience, and check my interview questions and whether their sequencing was appropriate (Van Teijlingen et al. 2001, p.33; Bryman 2012, p.473). Many of the questions in the interview schedule outlined above were developed following this pilot interview, and a few were dropped or reshuffled. One example of this was the addition of ability-streaming, which had not been a part of the original

plan but (for reasons we examined in the literature review section on egalitarianism) was a particularly fortuitous addition at this early stage.

4.2.4 Access and Timeline

For my first round of fieldwork, I was originally only equipped with three contacts for interviews. However, I was fortunate enough that one of these was a researcher at Japan's National Institute for Educational Policy Research (NIER) who was able to rapidly introduce me to further potential interviewees, and from there I was able to build my own network. The second round of fieldwork, now armed with a much larger network of interviewees, took place over a total period of four months and was based primarily in Tokyo.

One advantage of using semi-structured interviews compared to other research methods used in this area such as classroom observation and questionnaires, is their ability to yield very detailed data in a relatively short period of time. This allowed me a shorter timescale for fieldwork in comparison to other qualitative data gathering methods such as classroom observation (Walliman 2006, pp.92–93). Although I did not set out to try and verify my teachers' perceptions by observing them in the classroom, I was invited to observe several lessons in a few different schools across the ranking spectrum and even to chat with the students. However, this was often very useful for contextualising my interviews and getting a feel for the school beyond the promotional material available via websites etc. Interview length ranged from 35 minutes to almost three hours, but each interview was completed in the space of a single morning or afternoon.

I used snowball sampling for this thesis (Bryman 2012, p.202). I was either introduced to more potential interviewees (in person or over email) by those with whom I had already completed interviews, or was given the contact details of friends and colleagues who I then approached by email with a short introductory cover sheet. Other methods of gaining interviewees included asking friends (both from Oxford and from my undergraduate exchange

university in Japan) to introduce me to their old schools, networking at lesson study and conference events I was invited to, and also by pure serendipity. Although snowball sampling in this way can carry the risk of introducing bias, I was only ever referred to a single person by any given interviewee, and not all accepted. As my contact base grew, I was able to start to select for what school types were underrepresented in my sample (e.g. at first, it was poorer performing schools). Aside from the ability to grow my interviewee base rapidly, this method also allowed me to branch out into districts (and even ranks) that I had not previously been able to gain access to. Finally, I was usually able to interview other teachers (beyond the original interviewee) at a school once I had arrived; which helped eliminate the chance that people could only refer me to like-minded colleagues. All inter-school connections between teachers were noted to form part of the analysis.

4.2.5 Ethics

Qualitative techniques such as interviews can often fall prey to ethical problems, aside from the potential for bias to occur (Bryman, 2012). Approval was gained from Oxford University's Central University Research Ethics Committee in advance of field work, and the interview method and procedure for handling data was developed according to the British Sociological Association's (BSA 2002) guidelines – including compliance with the UK's Data Protection Act of 1998. I made sure teachers were aware that their identity would be protected, that their confidentiality would be assured via anonymisation in any text produced, and that their real names and schools would not be used in data (aside from signing the participant consent sheet). Demographic information (such as age, school type, and sex) was not kept with the interview data itself, and only linked through an NVivo classification sheet – no names were included. Each interviewee and the school they were teaching at was given a code, the details of which can be seen in this chapter.

Participants were asked to read a participant information sheet with project details and informed that, if they participate, their anonymity will be protected and that they can withdraw

consent at any time. Those who agreed to both the interview and its recording were asked to sign consent forms which made explicit and its recording, and for the transcription, storage and use of the audio data for this dissertation (Bryman, 2012:146-7).

During the transcription and translation process I made every effort to accurately represent what interviewees were saying, and I included any important context and made notes on tone throughout (Bryman, 2012:143).

4.2.6 Analysis

Analysing interview data is about "classifying, comparing, weighing and combining material…to extract meaning and implications" (Rubin and Rubin 2005, p.201). To help with the initial stages of analysis, for each interview case write ups were done as soon as possible afterwards (usually the same day). These summarised the main themes of the interview, any particular key words/phrases that stood out, and a note of any new leads and discussion directions that I wanted to incorporate into future interviews (Bryman 2012). Interviews were then transcribed, carefully including any information that affects interpretation (e.g. pauses, tone of voice) and noting key themes and concepts in this early analysis stage to help with later coding (Rubin and Rubin 2005, p.204).

For the initial coding process, coding was as open as possible and performed line-by-line for every interview (Bazeley and Jackson 2013, p.73; Thornberg and Charmaz 2014, p.157). This allowed me to employ a flexible, qualitative approach to coding. As the initial two rounds of analysis were conducted before I found most of the literature discussed in section one of the literature review, I let myself be guided by the data. I concentrated on coding for significant elements, "salient in the [interviewee's] social worlds", and generating as many relevant codes as possible and noting their connections (Bryman 2012, p.568).

I noted any key words and phrases found in the theory underpinning my research questions themselves, for example behaviours and activities associated with SE theory (i.e., effort, role-

models, etc.), the areas of achievement flagged as particularly gendered by OECD analysts, and the possibility flagged up by Fennema & Peterson (1986) that teachers may interpret success differently. These were then linked these broader themes (Bryman, 2012, p. 569; Thornberg & Charmaz, 2014). Examples of this for SE theory (i.e., "building confidence" or "girls are more anxious at putting their hands up in class"), and the difference between male and female students ("you can leave boys to it – girls only want to know what's on the test"). This initial process was the start of codes such as "girls anxious in class" and "hard to interest girls in applied mathematics".

These early stages were spent looking for commonalities between these coding categories, between teachers, and between questions. Recurring themes and phrasing helped to identify higher-order concepts. For example: categories like 'not possible to fix the gap completely', 'can try closing the gap', 'haul up those who need it, but…', and "could make the gap smaller" were combined to form a higher-order theme of 'Potential to reduce, but not close, the gap'. When pertinent, a specific comparison between different types of teachers from different types of schools was made in the context of their demographic differences (e.g., between male and female teachers).

For my latter research question exploring the mechanisms surrounding the barriers to problematisation of this issue, I was able to keep the *initial* analysis free from any influence by the literature. This was possible as, at the time, this question was not formulated as 'non-problematisation' but purely the seeming lack of interest and discussion of the gender gaps in Japan. Coding teachers' answers brought me to the literature on problematisation, and through following up on this new theory I was able to go back and group the codes into themes based on key attributes in problematisation examples. I developed my own framework of what to look for which is detailed in Section 3.3.3 in the literature review section on problematisation; and results were cross referenced with this framework to answer part of the final question on the mechanisms preventing problematisation of the gender gap.

In the same way as for the 'what' questions analysis, after the initial coding I concentrated on grouping codes by theme. For example, when asked about why the gender gaps had not attracted much attention in Japan, answers were coded repeatedly as "creating differences", "in the past it was different", "don't see them as boys/girls, just as individuals", this became "gender-blind" which later became part of a larger theme called "egalitarianism". Once codes like "gender-blind" started to emerge it was easier to link the analysis up with the literature and compare what was happening in my case with what happened in cases like those explored earlier in this chapter.

Throughout the process of analysis, contrasts between teachers and between questions, and the presence of recurring themes and phrasing helped identify higher-ordered concepts. For example; categories such as 'not possible to fix the gap completely', 'can try closing the gap', 'haul up those who need it' became the higher-category of 'Goal to reduce, but not close the gap'. These concepts have common sets of words and phrases that would come up repeatedly when talking about them, regardless of teacher variables. I was able to make specific comparisons between different types of teachers from different types of schools (e.g., between male and female teachers, private vs public school, etc.). However, as we will see, the results of this were usually surprisingly uniform much of the time. For example, regardless of school type, teacher experience or sex, or the age of pupils, teachers tended to use a common set of words (e.g. "diligent" and "neat") to describe girls and their behaviours.

The final, major, stage of analysis for each question was linking the higher categories and themes and exploring the commonalities and differences between them to form the base of my research findings (Rubin and Rubin 2005). These were then linked to each research question, and any overlaps noted.

4.2.7 A Note on Language

The interviews used in this thesis were conducted entirely in Japanese. To aid my analysis, I transcribed the interviews verbatim before translating them. Translated/transcribed passages sit alongside each other in my transcripts, and timestamps were included so that a quick reference

back to the original audio was possible. As suggested by Smith et al (2008), if a translation issue arose, I consulted with native speakers to resolve them.

The translations have been kept as close to the Japanese as practicable, so they can be a little raw as a consequence. For readability, I chose to translate some terms in Japanese into their equivalents in regular English usage – rather than literally. I ensured this was consistent across my translations to enhance the coding process. The most important of these to note for readers is my use of 'gender'. For words in Japanese such as *danjosa* (male-female disparity) and *danjo no chigai* (male-female differences), I commonly use 'gender difference' or 'gender gap/disparity'. Therefore, when teachers refer to 'gender' in the quotes used in this thesis, they are not using this in a sense of the sociological theory of gender (*jendaa*) unless otherwise noted. Likewise, I did not use the word *jendaa* in my questions to teachers.

4.3 Conclusion

This chapter has established the major theoretical frameworks used to inform my interview schedule, to help in analysis, or both. It also explained the specific methods used to carry out these interviews and examples of the coding and analysis process. The next chapters will present and discuss the empirical findings from this. These results are split broadly into two main categories mirroring my two main research questions: 'What?' (what are teachers' perceptions) and 'Why?' (why might they hold these views? What are the mechanisms preventing problematisation of the gender gaps in mathematics?).

Chapter 5 – Do Teachers See Gender Gaps?

5.1 Introduction

If teachers do not see gender gaps in achievement (or behaviour and attitudes), then non-problematisation is to be expected – what would there be to problematise in the first place? However, from our review of the papers and test data, it is not unreasonable to assume that teachers could have seen disparities of some sort in their experience. This chapter focuses on establishing a starting point to our investigations by addressing the first research question: whether, and (if so) how, teachers see gender gaps. Do they view their male and female pupils differently? Do they see achievement, behavioural, or attitudinal differences? Do they conceptualise these as being *gender* differences?

First, we establish whether teachers report differences between boys and girls in their own classrooms. 'Reporting' means a teacher mentioning a difference or disparity during the interview – regardless of whether they seem to be interpreting it as a *gender* disparity. As we shall see, these do not automatically go together. Next, we consider how many teachers state at the beginning of their interviews that they do not see gender gaps; what was their initial reaction to the question of whether they noticed any gender differences in their classrooms? Afterwards, we compare these two figures – did many say they did not see gender differences but go on to report them anyway? Finally, this chapter will set out teachers' most common observations of gender differences and introduce the four major themes of behavioural and attitudinal differences.

What we will find is that, although almost every teacher in the sample reported gender differences in their own classrooms, the initial reaction of a majority of teachers was to say that they did not think there were any – particularly that there were no grade differences. Fewer teachers denied behavioural and attitudinal differences in the beginning, but there were still those who had that reaction. The rest of this thesis will unpick the reasons behind these interesting patterns.

5.2 What are Gender Gaps?

Any comments by teachers pertaining to a difference between male and female pupils in their own experience of teaching at their current school counts. For the purposes of this chapter, teachers' observations of previous schools they have taught at, their own schooldays, and simply 'in general' are not included in this total – although we will still examine these comments and what we can learn from them in the coming chapters. Teachers were given the space to interpret the opening question, "Do you think there are any differences between your male and female students?". Some commented on behaviours and attitudes first, others on achievement. Others chose to comment first on achievement differences, what *aspect* of achievement they chose to refer to also has implications - we will investigate the significance of this in the next chapter. Clarification was sought, and additional questions asked, only after a teacher had given their initial answers.

For achievement gaps, any statement indicating a difference between the performance of male and female pupils was counted. These included 'official' grades, class progress tests, scores on homework, and teachers' evaluations of pupils' understanding of the material. For behavioural and attitudinal differences, any differences, or patterns, in how boys and girls were described were noted – whether these were framed in a positive or negative way.

5.3 The Gender Gaps in Grades and Achievement.

Do teachers think there are gender gaps in achievement? The answer is (unsurprisingly) more complicated than a simple 'yes' or 'no'. To tackle this, we examine whether teachers describe or report any differences in pupil performance between boys and girls – regardless of whether they put forward these descriptions as being gender differences. Once we have a baseline of how many teachers do report differences in achievement, we will compare this against their initial

reactions. In this way we will be able to see just how many people's initial reaction was 'no', but their interview said 'yes'.

5.3.1 Evidence of Gender Differences in Achievement.

Almost every teacher interviewed for this thesis described gender differences in achievement in their own classrooms. The differences they noted were a mix of the kinds of features that popped up in the literature we have examined, and those that were not flagged up by that data. We will explore these characteristics that teachers describe in greater detail over the coming chapters. The aim of including these numbers here is to act as a guide to magnitude of agreement (or not) between teachers, rather than to make any claims of statistical significance.

Teachers can here be grouped into three types:

Group 1 (84%) Teachers who reported gender differences in their own classrooms at their current schools.

Group 2 (8%) Teachers who did not report a gender gap in their own classrooms at their current schools. However, two of these three teachers were explicit that they saw gender gaps at previous teaching positions.

Group 3 (8%) Teachers who lacked an (official) comparator. This included the teachers currently at single sex schools and the trainee teacher who had been working at her current school for less than a full academic year. They did report gendered achievement traits in their current pupils.

Researcher interviews also corroborate these findings. They all agree -regardless of the exact causal reasons behind them – that there are indeed gender gaps in mathematics achievement (and attitudes). We will go through each of these three groups in turn for the rest of this section.

Group 1

Most teachers did report gender differences in achievement in their classrooms. It is important to reemphasise here that this only means the number of teachers who gave evidence of gendered achievement disparities; they do not necessarily state outright, or specifically frame, these *as* gender differences (at least at first). The vast majority of teachers described more than one gender achievement difference, although there were a few who only specified a single one.

The sample for this research draws on teachers of both sexes, with a wide variety of ages and experience levels, and who are currently teaching (and have taught) in a broad spectrum of school types and ranks. At 84%, and considering the diversity of this sample, we can state with some confidence that there is evidence that teachers see gender gaps in achievement in their own classrooms.

Group 2

Three teachers stated that they did not see achievement/ability differences in their current schools. However, two of these teachers were explicit that this had not been the case at other schools they had taught in in the past; they stated that the reason they did not currently see any achievement gaps was because of the particular features of their current school.

Although M1.1 and TM did not report any gender achievement gaps, they were immediately and extremely clear about why that was the case. It is also worth noting that all of M1.1's colleagues interviewed for this thesis did actually report gender gaps in achievement. Only one teacher in the whole sample, Z14.4, did not report any gender achievement differences in her own classroom at all – she had not seen them personally elsewhere either. As with M1.1, we can see from interviews with her colleagues that they do report gendered achievement differences in her school.

Group 3

We have reason to believe that this trio of teachers would be 'maybe/likely' to see gender differences in achievement if they were in another situation - based on how they describe boys and girls during their interviews. Two of these teachers were teaching at single sex schools at the time of their interview – one at an all-boys school and the other at an all-girls school. Obviously, this meant that it was not possible for them to see (or not see) a gender gap in achievement at their current schools. Lacking a comparator group all they could do was comment on their current students and compare them to those of the opposite sex they have taught elsewhere. For example, KHW, teaching at a mid-to-well ranked private all-girls school, saw the same kinds of mathematics-area specific performance disparities in her female pupils (particularly when it came to shape/space questions) as many teachers in Group 1 did. KM1, teaching at one of the top all-boys schools in the country, similarly recognised gendered trends – she even said she saw these amongst her own children at home. Therefore, although they should not be officially counted as part of the 'yes' Group 1, their interview lends support to the view that teachers can report gender disparities.

The third teacher, B2.2, was a graduate student trainee at the time of her interview; she had been teaching less than one full academic year. She was, therefore, unable to comment on some of the most frequently cited differences such as whether she noticed a change in gender achievement over time across year groups. Despite her (relatively) limited teaching experience, if we take into account her reaction to (and explanation of) the PISA data, and the references to her own recent experience of school life, we might predict she would see these 'classic' differences after more time spent teaching. As above, looking at the interviews with her colleagues at School B, that they all reported gender differences in achievement. Now we have established that the vast majority of teachers report at least one gender difference in achievement, the next section shall investigate whether teachers seem to recognise them as such.

5.3.2 Achievement: Teachers' Initial and Changing Stances

Teachers do report gender differences in achievement, but do they *see* them as gendered? There is a difference between teachers reporting evidence for achievement gender differences and actually conceptualising them as being a gender difference. Many teachers' initial reaction was to say that there was no gender achievement gap – at least none where boys were doing better than the girls.

65% of teachers stated at, or near, the beginning of their interviews that they either did not think there was a gap, or that girls were actually the higher performers. Of the 65%, around half said that girls had higher grades (most specifying 'slightly') and the other half felt there were no differences.

At a first glance, this is difficult to reconcile with the large numbers we saw in the previous section; which showed that almost every teacher reported achievement gender differences. However, this foreshadows the discussion for the rest of the thesis: that this initial reaction was not necessarily indicative of what teachers really know and notice about gender differences. Chapter 6 will tackle the nuance behind what a teacher actually counted as an achievement difference – we will see that this is critical to the problematisation process.

Almost nobody maintained throughout their interview that they saw no achievement differences at all between boys and girls in the classroom. Some teachers tangibly changed their minds as the interview continued (even saying 'actually, now that I think about it…' and similar), and others did not change their mind so much as make their reasoning clearer for what they counted as a gender difference in achievement. Of course, there was also those (not in the 65%) who were upfront that they *did* see achievement gender differences in their classroom too.

Still, 84% of teachers reporting gender differences in their classrooms vs 65% of teachers initially stating that there are not any gender differences is an interesting conundrum. How this can be the case will be the focus of the rest of the thesis; what are the features that can lead to these different stances – some of which are radically different even from those of their colleagues

teaching in the same school. As a point of interest, whether a teacher was 'upfront' or changed their mind about the gender gaps was not a good predictor of how they actually felt about the gender gap. Whether teachers felt that the gender gap was a problem, something in need of addressing, will be covered in the next chapter.

Almost every teacher reported achievement differences between boys and girls in their own classrooms. We have also seen that a majority of teachers (at least initially) did not feel that there was a gender achievement difference (or felt that girls were actually doing better than boys). Next, we will repeat the process but with teachers' perceptions of behavioural and attitudinal differences in their classrooms.

5.4 Gender Gaps in Behaviour and Attitudes

In this section we move on to consider whether teachers reported any contrasting behaviours or signs that their male and female students feel differently about mathematics. Then, as in the last section with achievement, we will compare this to how many teachers started off their interviews by saying that they did not think there was anything of note to report.

5.4.1 Evidence for Gender Gaps in Behaviour and Attitudes

Rather decisively, all but two teachers reported differences in behaviour and attitudes: M1.1 and B1.1 – two male teachers of a similar age and experience level, both teaching in elite national schools attached to prestigious universities. Even then, it is debatable whether they do truly fit the 'spirit' of this category; M1.1 again caveats his answer by saying that he sees differences in general (including at previous schools he has taught at). Meanwhile, although B1.1 reported no differences himself, he explained that he had asked his pupils their views on whether *they* thought there were gender differences. He relayed that they thought there were plenty – moreover, these differences line up perfectly with those described by other teachers.

As before, it is useful to compare their response to those of their colleagues teaching at the same school. In both cases, all their colleagues reported differences. Interestingly, Z14.4, who was the only teacher to not report any achievement differences at all in the last section, was on the opposite end of the spectrum when it came to behavioural and attitudinal differences. She reported many of them, and which matched up perfectly with those of teachers who also described achievement differences in their classrooms.

The three teachers placed in Group 3 in the achievement section – those in single-sex schools or had not been teaching long – all made strong statements that girls and boys acted in certain (different) ways, and that they felt differently about mathematics. Therefore, here we will consider them as part of the group that does notice gendered behaviour and attitudinal trends in their students – particularly as what they say is essentially the same as those teachers in the other groups.

5.4.2 Behaviour and Attitudes: Teachers' Initial Stance

There was a much bigger consensus from the beginning when it came to whether teachers saw behavioural or attitudinal differences as gendered: 80% of teachers either stated that there were gendered behavioural and attitudinal differences outright, and/or even described a difference, within the opening minutes of the interview. There seemed to be far more interviewees who were comfortable saying that there were disparities in these areas compared to achievement differences.

Of the remaining 20% of teachers: around half were those who stated outright that they saw no differences, and half were those who made ambiguous statements. Of this 20%, there were also a few who changed their minds within the course of their first sentence - a very quick reversal!

Interestingly, it is here that we do see a pattern depending on demographic differences. With a single exception, the interviewees who initially stated there were no gender behaviour/attitude

differences were teachers in the poorest performing school in the sample, along with a few teachers from the two elite national schools – albeit for different reasons. However, it is worth noting that, yet again, this was not the consensus of their colleagues in any of these cases – several of whom were some of the most insistent on there being gender differences in behaviour and attitudes in the classroom.

Teachers seem more comfortable describing gender differences in behaviour and attitudes. This provides an obvious contrast between teachers' initial reactions: 80% of teachers here *did* conceptualise these differences as being gendered vs 65% of teachers did *not* conceptualise achievement differences as gendered in section 5.3.2. We will tackle some of the reasons that that might be the case in the coming chapters, but next we will briefly explore whether teachers recognise gender differences 'in general' if questions move the focus from their own classrooms to include the world outside too.

5.5 On The PISA gap

One of the most intriguing moments of an interview was seeing how a teacher reacted to the news of the PISA gender gap – especially if it may be unexpected based on the conversation until that point. Virtually none of the teachers had heard of the PISA gender gap prior to their interview, even though most had heard of the test itself and many had a general idea of where Japan stood in the international rankings for mathematics. We will return to the issue of PISA and what teachers think is behind the gap in the next chapter, but it also has an important implication which should be noted here.

In Sections 5.3 and 5.4, we saw that teachers do see gender gaps both in achievement and in attitudes/behaviours in their own classrooms; but so many teachers said there were no gender differences at the beginning of their interviews. In some cases, it was discussing the PISA gap that proved to be an effective way to 'smoke out' teachers' thoughts on gendered achievement

differences. Even if a teacher said there was nothing going on in their own classroom, they usually did think there was something happening 'in general'.

Towards the end of the interview, after thoroughly discussing their perceptions of the situation in their own classrooms, teachers were told about PISA, given the basic numbers, and asked for their reactions and explanations. Only one teacher (BH.Y) knew the specifics of the data, otherwise teachers were not aware of the PISA gender gaps before their interviews. The vast majority of teachers were either unsurprised or 'not very surprised' by the data. Over half of that group said that they actually "knew that, somehow…" and guessed that girls were being outperformed by boys anyway. Their explanations for why the gap existed even lined up with those of the researchers interviewed. Of the few who were taken aback by the PISA gap, the surprise did not last long; instead they were also able to explain and rationalise the data. Only two teachers could be described as being *shocked*, and one still rationalised it quickly.

> The reality? Hmmm. It's got that kind of 'Now I come to think of it…' feeling to it. I feel like there's a lot of girls who feel they're not good at maths. Who have an aversion to thinking about mathematics . It's like I said before, I think there's more girls who aren't good at thinking rigorously 'That's a pain', 'let's get to the end' I think there's more girls like that. - M1.2

Interestingly, it was not just those who had initially said they did not think there were gender gaps in their own classroom who found the PISA gap unexpected. TO2.2 was one of the few teachers who was shocked (not just surprised), even though he was clear during the interview that he saw grade differences opening up over time. He still found it hard to accept that boys were scoring so much higher according to PISA: "Yeah well that boys are much higher than girls at fifteen? Is that right? Yeah I don't see that…". After discussion on a different topic, trying to clarify his views again showed that he had changed his mind - he confirmed that he did indeed see gender gaps in achievement and that he would actually expect boys end up with "considerably higher" grades by the time they reach high school.

Few teachers were surprised for long by the facts of the gender gap (that boys do much better in mathematics), but what took some aback was the idea that Japan's gap was unusually

large. A memorable example was Z14.5, who registered only the very mildest surprise ("oh, I see") when told that boys outperformed girls significantly in the PISA tests. However, he did a shocked doubletake when told that it was one of the widest disparities in the OECD.

A critical insight gained from the reactions to PISA is that it often provoked discussion about the difference between getting good grades and actually being good at mathematics. We will explore this in more depth in the next chapter.

> I wonder…That there's a such a large gender gap, I thought 'ah, yeah sure'. That boys are higher, right? And girls are lower? [Interviewer: yes] Yeah, I can understand that. The PISA tests are totally different from our exam questions, I get the feeling that they're quite unusual. I can accept boys getting better grades in that. - X4.2

As we shall see over the coming chapters, the reasons behind how teachers conceptualise gender differences are complex and borne of many inputs: both inside and outside the classroom. The majority of teachers were not surprised by the PISA gap, even considering how many interviewees stated initially that they did not think there were achievement differences. In the rest of this chapter we will introduce the main categories of gender differences.

5.6 Achievement Difference Categories

The previous sections suggest that teachers do report achievement gender disparities, even if they often do not conceptualise them as such at first. Here, we look at the main categories of differences in their own classrooms reported by teachers. An example per category is also included.

Change Over Time

This is arguably the most important category of gender difference, and it will be a critical part of the next two discussion chapters. It was also the most common kind of achievement difference

reported, with a big majority describing how gender gaps in grades shift over time. Behavioural and attitudinal change over time was also noted.

In this narrative, girls begin their middle school careers either with higher grades than boys or with no visible difference in grades. However, as they move through the school years, the achievement disparity either reverses -whereby boys overtake the girls and their grades end up higher overall - or girls' early lead is whittled away to nothing.

> There isn't really a gender grades gap…but if I think about it by year then it is a bit wider by 2nd year… - Z14.2

> [Int: So, if I can clarify, the boys catch up with the girls by the third year?] Yes. And slightly overtake. Yes. – M2.2

This is consistent with the findings of both Isa and Chinen (2014) and Uchida and Mori (2016) which we examined in the opening chapters of this thesis. It is also accordant with what we know of the two international test results: PISA (which has a bigger gap) tests 15 year olds, while TIMSS (which has a smaller one) focuses on 9 and 14 year olds. As well as examining different content, the tests catch children at different ages, year groups, and stages of completion of the material.

There were two main variations: teachers who only felt that boys 'caught up' with girls, and those who felt that boys not only closed the gap but 'overtook' (*oikosu*) girls. Most teachers were in the latter category.

Differences by Mathematics Area

Many teachers explained that certain question types were more likely to show gender disparities in achievement. The most common areas girls were reported to struggle with were anything that requires spatial awareness: 'shape/space' questions, areas, mental rotation and similar. Meanwhile, this was occasionally juxtaposed with girls' stronger (though not necessarily better than boys') performance in algebra or any types of question that are either 'wordy' or

straightforward. Observations that girls were better at subjects like English or *kokugo* are also associated with this type of response.

> At our school there's a bit of a difference between the grades of male and female students. Boys are, of course, a bit lower. But, in shape/space questions and in comprehension, boys are a bit stronger, I think, if you're looking as a whole. In that respect boys surpass the girls. – M1.2

Even one of the few teachers who did not report these differences -Z14.5- did so whilst acknowledging the idea that women and girls having poorer spatial skills was a commonly held belief. He seems to be aware that he might be expected to see a difference like that.

Like 'change over time', this was another gendered variation in achievement seen in the literature. The analysts of the PISA 2012 test results flagged up score disparities depending on the type of mathematics dealt with in the question – although this was a general finding, rather than something specific to Japan.

Not in Class, but 'Outside'

Connected to the above, a very common type of response concerning achievement differences was the interviewees explaining that girls struggle when they encounter questions that are harder than usual, or if asked to apply their knowledge to unfamiliar mathematics. Teachers might caveat this by saying that the girls' grades themselves tend to be good.

Here, the idea is that girls do well (or well enough) according to the most visible metrics available to teachers such as homework marks or classwork tests, but that their actual competence and mathematical ability is weaker than those numbers indicate.

> I think the gender gap are really interesting. Like with easy school tests, girls will get better test scores. They do. Simple tests, simple lessons, the sorts of problems set in class they can do. But when it comes to hard problems, that changes I think. That's why, boys will from a lot of different perspectives…like whether it's a brain structure thing or…with girls they're being girly or…it's that kind of thing. - SK3

This idea was so prevalent that even teachers who were in Groups 2 and 3 – those who did not report differences in their own classrooms - referred to it during discussions of the PISA gap,

and even while chatting after the formal interview portion was complete. This included teachers like Z14.4 who had been clear that she saw no achievement differences in her own classroom – although this might well be her only counting grades as important, something we will explore more in the next chapter. Even B2.2, who had at that point comparatively little first-hand experience of teaching, raised this as a reason she thought the PISA gap existed.

Talented Boys with 'Flair', 'Flashes' of Inspiration, Conceptualising Power…

Many of the interviewees described boys as having ability when it came to mathematics. They expressed this in different ways: some said that boys had a flair for the subject, or had flashes of insight which allowed them to make conceptual 'jumps' – particularly when it came to harder or more complicated questions. Although the terminology varied, it was clearly a common position of many teachers in the sample. What is equally interesting is that this kind of language was never used for girls – even high performing ones.

> So, when I think about 'how can you solve [this difficult question]' it was boys who were solving it with flashes of insight. The girls with that kind of spark of intuition…there were not many of them, that's my feeling. That's probably my own bias, I don't know if it's true but… - BN3

Another variation on this kind of answer concerned cognitive ability differences. These teachers described boys, often in direct comparison with girls, as having greater conceptualising power (*hassouryoku*) thinking power(*shikouryoku/kangaeru chikara)* or a better ability to grasp mathematics (*haakuryoku/toraekata*).

> with the [textbook style] question type I think that girls will be good at those, fundamental calculations or knowledge understanding…in terms of technical ability they're good. But when it becomes about thinking ability then boys are more… T.1

The final variety was a teacher simply commenting that boys were better at maths in general.

> Actually, conversely...the aspect we call 'mathematics' boys are often better at solving and girls have lower grades. Instead, for example, if it's literature content then girls do better, and conversely maths is just one aspect where that kind of gender gap exists. -Z14.3

Boys' Achievement is Polarised

According to teachers, boys were more likely than girls to be really good at mathematics and they were more likely to be really bad at it too. These kinds of responses paint male students' achievement as more polarised than that of their female classmates, with girls' performance clustered more around an average.

> There's not many [girls] who are bad, and there's not many who are really good. Boys are…really striking in that even when the *average* is about the same [as the girls] there's a big difference [in mathematics] compared to other subjects – X4.1

The image of girls being good (or at least fine) at mathematics, but not great at the subject is one we will return to in Chapter 6.

> If the top student was a girl and the worst student was a boy then I think I'd have an image that girls were better at maths than boys, but both of them are boys. Girls' [grades] are a little higher on average, so I suppose I've never really noticed anything... B2.3

This was also sometimes echoed in statements by teachers who taught ability streamed classrooms. Only one of these teachers said that his bottom ability set was majority female – everyone else commented that girls tended to be in the top and middle sets even if they were not the 'top' students. Girls' average could be higher, but they were usually not the best (or worst) students in the class. These statements were often directly associated with the behavioural differences we will explore in the next section.

In section 5.6 we have covered the major types of achievement differences that teachers mentioned during their interviews. Some of these are familiar from the literature, such as girls reportedly having more difficulty with certain types of questions and the fact that teachers see performance disparities changing as pupils move through the school system. Others, like girls struggling with unfamiliar mathematics or having poorer conceptualising ability, are examples of new factors for us to consider over the coming chapters.

5.7 Behavioural and Attitudinal Categories

Now we turn to the behavioural and attitudinal differences that teachers report concerning mathematics. As before, we will look at the largest categories in turn, and include an example.

Boys are Assertive, Girls are Quiet

This very common kind of reply includes both the behaviours, and the general demeanour associated with girls being 'quiet'. Many of these observations are consistent with what we would expect teachers to see based on the importance of self-efficacy as per the PISA analysts.

This category includes behaviours and attitudes related to confidence. Girls were described as putting their hands up less (to ask for help and to volunteer answers or comments), calling out less (for the same reasons), evaluating themselves differently to boys, and several other differences that relate to confidence.

> I feel like maybe boys call out a little more. Girls steadily get shyer and don't put their hands up. If you call on them then they answer you but…there becomes fewer and fewer girls who will voluntarily put their hands up even if they know the answer. Well…they don't tend to put their hands up to answer questions, but they do to ask them when they don't understand something 'I don't get it' [Interviewer: and boys?] There are boys like that but there are also boys who will just be like "I don't get it' out loud, when they want. – Z14.4

Not every teacher who reported these differences felt that they indicated girls had issues with their confidence. The most striking example of this was T.1. She had listed multiple examples of girls displaying these kinds of behaviours, but also stated outright that she did not think girls had lower confidence.

This was also a common 'change over time' behavioural difference, with girls getting less assertive and less confident as they moved through school.

'Buzzwords'

This large category is a conglomeration of common attitudinal traits teachers associate with girls. They have been grouped together under the banner of 'buzzwords' because the terminology

used is always the same, and they are often mentioned together as a package. Almost every teacher used at least one, with the most using more than that.

According to teachers, girls are 'neat' and 'organised' – for example, when it comes to writing out their notes or when doing their homework. They hand in their work complete, on time, and it is legible etc.

> Girls are the ones *really* neatly taking notes. At this school they're really neatly doing their notes and their outlines, and they really want to take their notes prettily. Boys are more like *bloop*, but for the important bits they do take their notes carefully… M2.2

Girls are also described as 'grown up', dependable, or well behaved. Girls are quiet when the teacher (or others) speak, put their hands up to ask questions (or, more rarely to volunteer), sit still and get on with their work when asked. This was frequently invoked as a direct comparison with boys who were often described as being childishly disruptive.

> Well, like I said, boys have…slightly higher scores. But normally, during class, well, girls are more diligently taking notes. It's like 'girls are good kids', and 'boys are noisy' [laughs] – B2.1

By far, the most frequently used word to describe girls was that they were diligent (*majime)*. Diligent, steady, hard-working girls who approached their work in a very steady (*kotsukotsu*) way. As we will return to later, this was often associated with girls preferring (or needing) to have things explained in a step-by-step fashion.

> Girls are always doing their best, diligently… for example, every time I give them homework with boys there's a lot that aren't very diligent…even if I give them homework, they don't do it properly… - BN3

Boys also have their corresponding descriptive terms, although these were not as commonly used. The two most frequently used were that they were noisy (*urusai)*, and that they were slapdash (*zatsu)*.

Boys are Curious and Interested, but Girls Dislike Mathematics

One of the most frequently reported differences, this attitudinal disparity, came in a few variations. It includes any references to boys enjoying or liking mathematics more than girls such as: finding something they were taught in class interesting (because they told the teachers so), finding and communicating links between mathematics they learnt at school and the outside world, responding to a task with more enthusiasm or curiosity etc. Conversely, it also includes any references to girls *not* liking, or seeming uninterested in, mathematics. Again, this could be verbal ('what's the point of this?') or communicated through their behaviours.

> If we limit it to just kids who are good at maths…then they have interest in maths regardless of gender but…I think boys have a stronger interest. That's the image I have. - X4.2

Teachers' perceptions of girls' interest and how they think it affects their strategic choices is a theme we will return to.

Girls are Afraid of Embarrassment and Failure / Boys like Challenges

Girls are described as being frightened of being wrong, and behaving accordingly, by many teachers. They often contrasted this to boys' confidence and willing to challenge themselves. Although it is related to assertiveness, it is treated by teachers as a separate trait.

Girls were described as avoiding situations where they could be embarrassed or end up being disappointed in themselves. This was especially true for public situations such as volunteering answers, but was also visible in classwork where the only 'audience' was themselves. Teachers also said that, when girls do volunteer a comment or answer, they tend to caveat and hedge their views before they give them. Other views expressed include that girls give up quickly, ask for help too quickly or too often, or (conversely) not asking for help when they need it.

> There's more boys who will assertively call out, the assertive ones are boys. Assertive? Or unafraid of being wrong… boys aren't really too worried even if they do get things wrong. Girls find being wrong embarrassing so…'it's better not to answer' they distance themselves. [more self-conscious] yes. - Z14.6

Teachers often contrasted their female pupils with their male ones in this case. Boys were described as liking a challenge (a hard, or unfamiliar mathematics question, for example), comfortable with taking risks, and undaunted by the prospect of failure.

Girls Want Good Grades…but Give Up Too Quickly

This category includes all references to girls wanting to achieve good results and do well in mathematics (and often in their other subjects). It also includes any references to girls prioritising getting a question (therefore the grade) right over learning the mathematics thoroughly. This also includes teachers' examples of girls prioritising their efforts elsewhere in other subjects.

> because…of course…I think girls hate to lose - they want to win. Wanting to gain knowledge, to understand more, it's not that feeling, it's 'ah, I'll wait for someone to teach me' for example 'they won't put their hand up, "if I wait the answer will just plop down", I think there's a lot of girls like that. M1.2

This was associated with the idea that girls do not like or enjoy mathematics –but they were treated as two separate concepts by teachers in the interviews. We shall explore this in depth over the next two chapters.

Boys Think Flexibly, Girls are Rigid…Boys Think Clearly and Girls are Scattered

Teachers describe their pupils' thought processes in two main ways. Some teachers said boys are able to think in 'many different ways' or 'flexibly', while others describe boys as 'clear', 'practical' or 'mathematical'. Interestingly, a few teachers fell into both camps. This category also includes any mention of girls in the reverse: girls being described as either too 'scattered', or too inflexible in their thinking.

> They're able to do what we'd done up till now really well, but from that point on if you make it a bit more difficult, girls really…girls are said to be bad at thinking flexibly. In contrast, boys, even if ordinarily they look like they're not really

> properly participating in lessons, if you think of it in this way, it's not about being easy…but it seems like boys are strong at quickly switching ways of thinking. - SB1

This set of differences has links to the branch of 'talent' achievement differences we saw in Section 5.6. If that focused more on the processes (i.e. the behaviour), this focuses more on the mental abilities associated with them.

Girls 'Need to See the Point' or ' No Test? Not Worried'.

This category includes all references that teachers made to the idea that female pupils only care about mathematics that they will be tested on.

> For girls particularly right? Well for boys, if it's interesting they'll do it [laughs] puzzles and things…like more than the meaning behind it it's about whether doing it is fun. For girls, if they don't see the 'reason' then they don't continue with it. "Why are we studying this?" "How is this useful?"…If they can't understand the meaning then they can't get past that. - M1.3

It also includes the differences (usually the difficulties) in motivating girls to take an interest or to work at mathematics beyond the minimum needed for school tests. This is linked to the prior category whereby teachers describe girls as less interested. This idea also plays a critical role in Chapter 7.

5.8 The Four Themes

In Sections 5.6 and 5.7 we have seen interviewees describe a variety of attitudinal, behavioural, and achievement differences between boys and girls; from this we can also identify four overarching themes in the teachers' descriptions. These are: Personality, Interest, Ability, and Choice. As we will explore in the coming chapters, these different themes overlap and interact in ways that obscure gender disparities and form the bedrock of the rationalisation of gender gaps. Arising directly from our empirical data, these themes form the backbone of the analytic framework used over the next two chapters.

Theme 1: Personality Differences

Interviewees described girls in specific ways. First, in positive terms: girls are described as diligent, hardworking, 'grown up' and well behaved. Girls are considered by their teachers to be neat, organised, and dependable. Equally (seemingly) positive, girls are concerned with being right and want to do well. The language used by teachers across the spectrum is strikingly similar, and often used as a 'package'. These were very often the first gender differences acknowledged by teachers, and even frequently used in their initial statements that they did not think there were grade differences (or that girls were higher).

However, as interviews progressed, a much less flattering set of descriptors were just as commonly used. Boys are assertive and girls are reserved; boys are confident, and girls have little confidence and low self-esteem; boys like a challenge, but girls are anxious and afraid of making mistakes. None of this necessarily contradicts the first 'image' that teachers painted of their female pupils, but seemingly reflects the converse of it.

Theme 2: Interest Differences

Girls were described as disliking mathematics - even hating it. Teachers also reported that while boys engaged with mathematics both during and out of class and showed interest in the material by asking extra questions, girls only seemed concerned with their grades or what was 'on the test'. Girls seemed anxious not to be wrong and were taking steps to avoid it.

Boys were described as curious, enjoying challenges, and going beyond the minimum needed for class to delve deeper into maths – for the pleasure of it.

Theme 3: Ability

Boys were described as better equipped to take on mathematics questions that required application of knowledge, rather than just replicating knowledge that had been studied in the classroom. Girls apparently struggled on areas of mathematics that required certain cognitive abilities such as shape/space and mental rotation, while they excelled at subjects other than

mathematics that required different skills such as English or *kokugo*. Boys were also described as more expressive, flexible, logical, and innovative. Teachers also referenced boys' and girls' physical developmental differences as well.

Theme 4: Choices

Teachers commented on how boys and girls choose different strategies, including boys choosing to work hard predominantly as entrance exams draw near. Or that girls might choose to prioritise other subjects over mathematics, sacrificing depth of knowledge (in mathematics) for breadth. Some teachers also traced behavioural and attitudinal disparities and their resulting achievement differences back to incentive differences borne out of girls making different career choices to boys.

These themes split again into two camps, we will focus on each in turn in Chapters 6 and 7. Chapter 6 will focus more on how the factors seen in Themes 1 and 3 (Personality and Ability) interact to obscure gender differences and to block problematisation. In these themes, agency is not emphasised in the same way as in Themes 2 and 4 (Interest and Choices). Chapter 7 will focus more on the latter. Separating these themes completely is not possible, as individual teachers will usually draw from different aspects across all of them. However, these two camps represent streams of thought which, when they do form a whole, help explain how conceptualising the gender gaps as a problem becomes so difficult.

5.9 Conclusion

This chapter has shown that (almost) all teachers reported gender achievement disparities between boys and girls in their own classrooms. Despite this, a majority (65%) also stated that they did not think there were any achievement differences at the beginning of the interviews. In contrast, we saw that 80% of teachers were upfront about seeing behavioural and attitudinal differences, and almost every teacher reported some in their own classrooms.

We can conclude, even without further analysis, that teachers are more comfortable with disclosing what they perceived as behavioural and attitudinal differences between boys and girls than they are with discussing achievement disparities. This was true even when discussing behavioural differences that they themselves identified as being key *for* achievement, as we shall see in the next chapter. Teachers talk about their students in surprisingly similar ways to each other, considering their schools' diversity (and their own). Strikingly, there also many similarities to how teachers in 1980s UK spoke about their students; including descriptions of girls as 'neat', 'conscientious' and 'obedient', and boys as 'adventurous, independent and boisterous'. We shall see in Chapter 6 whether the teachers in this sample agree with one teachers' statement "although girls tend to be good at most things…it's going to be a boy who's your most brilliant pupil" (Clarricoates, 1980, p. 33,39)

Another key finding visible at this stage is how, despite the diversity of the sample, the patterns of achievement and behavioural/attitudinal differences that teachers saw were strikingly similar. Teachers in elite national schools reported many of the same trends and features as those teaching at the poorest performing public schools – even teachers currently working in single sex schools reported many of these, using the same language, even without having a current direct comparator. We have also had our first signpost that teachers see differences between the various types of achievement differences – their reaction to PISA highlights how they categorise them differently.

In the following chapters, we will explore the themes we have introduced here. We focus particularly on how the themes interact to produce the variety of responses we have seen in this chapter – including how so many teachers' gut reaction could be that there was no difference, and how they can share so much of their reasoning with the teachers who said there were achievement disparities from the very beginning. As we move through the rest of the thesis, we will see different themes foregrounded at different times while others take a backseat in teachers' rationalisation process.

Now that we have established with this chapter that teachers do see gender differences, the next question to tackle is how they can do so but not necessarily recognise them as gendered per se. In Chapter 6, we start by exploring the first major branch of rationalisations and how it affects problematisation of the gender gaps in mathematics.

Chapter 6 – Barriers to Recognition and Problematisation

6.1 Introduction

Chapter 5 ends with a conundrum: how can there be such a discrepancy between teachers reporting achievement gender differences and how few seemed to conceptualise them as such up front? This chapter explores the first angle of reasoning behind why so many teachers had this initial reaction, and how understanding this reaction can also help also explain why there might still no problematisation - even from those teachers who did state there were gender achievement gaps from the very beginning.

We begin our investigation by taking up the leads from sections 5.5 and 5.6 in the previous chapter: that teachers may see a difference between 'being good at mathematics' and 'getting good grades'. Our first task is to establish what teachers think is necessary for a student to be good at mathematics, and then compare this against how teachers describe their female students. Then we explore how teachers view and value different types of mathematical ability, and what their assessment of girls means in this context, and for the recognition of gender gaps in achievement in mathematics.

Knowing this, we will then examine the three main reasons behind how the gender gaps can remain unseen: credentialism, perceptions and lenses, and how differences that teachers perceive to be innate (or inevitable) interact to obscure recognition and block problematisation. The themes of 'Personality' (Theme 1) and 'Ability' (Theme 3) will play particularly strong roles in this chapter. A key finding from this chapter, which will provide a stark and crucial contrast to the core of the next chapter, is that in this 'side' of the explanation for a gender achievement gap there is very little agency attributed to anyone – especially girls themselves.

We will also tackle how interviewees feel about the prospect of finding a solution to the gender gaps in mathematics - including whether they think it is possible, or even desirable, to try.

Understandably, if teachers do not think it is an achievable goal, this would be a very serious barrier to problematisation indeed. The reality is, as we shall see, more complicated than that.

6.2 Getting Good Grades versus Getting Good at Maths

In Chapter 5, we alluded to the idea that teachers see a difference between being good at mathematics and being able to get good grades in mathematics. In this section, we establish what exactly this means to the interviewees, and what relevance this has to the question of problematisation of the gender gaps.

6.2.1 Comparing 'Girls' and the 'Ideal' Mathematics Student

Teachers were asked in general terms, and deliberately without specifying gender, what they thought was important for pupils to get good grades in mathematics. Responses can be grouped into five key sets of factors. We will look at each of these and compare it against how teachers have described girls as we set out in Chapter 5.

6.2.1.1 Practice and/or Hard Work

Most interviewees referenced the idea of practice as a basic requirement. Teachers spoke of repetition, spending time outside class working on mathematics, using daily practice to increase exposure to, and familiarity with, mathematics, and improving calculation speed and accuracy as building blocks for becoming good at maths.

> The first is knowledge. The second is calculation ability. You have those two and you're good. If you don't have the knowledge then your conceptualising power won't develop… - Z14.4

> Practice. Practice, repetition of practice. Then, various questions…there's a big difference between those who have daily contact with maths and those who don't. If you use some time every day to have contact with maths then, naturally, your ability - even if it's just a little time – really, surely, even [with] just 5/10 mins of doing maths every day, then your maths-related senses and awareness will also increase. And your maths ability will also grow. - M1.1

> Hm…practicing things again and again. With mathematics, it's…your way of thinking is also important….And being able to do calculations quickly and accurately you need to do it many, many times. Studying by repeating things is important. I think. - Z14.5

At a first glance, girls seem like an excellent fit for this requirement. Referring to Theme 1 (Personality) set out in Chapter 5, teachers describe girls as diligent, hard-working, and as having a desire to tie up loose ends and make sure their work is neat and complete. TO2.1 said of girls "…female students work seriously hard. And their answer sheets are really neat".

> Girls are definitely more diligent…….Girls are really, steadily studying…and that doesn't really change much – the amount that they study. Boys don't work. Then they do, suddenly… - X4.2

> While I was going to grad school and working part time, I taught for two years at third year middle school. And it was a mixed school…but I felt like the girls were more diligent, handing in their homework and things - KHW

This praise was often combined with an observation that these behaviours compensated for girls' weaknesses elsewhere, mentioned alongside another more negative trait, or couched with an explanation of how this strategy would not continue to work in more advanced stages.

> The gap isn't really big, I think. Yeah…well there's a lot of girls who are diligent and careful so even if they're not particularly good at maths it balances out for the tests. There's a lot of girls who practice carefully and get the grades. Boys are more: if they're bad at it, think 'nope' and quit – there's a lot of those. -NA1

> As a subject? Well, I think you might be able to tell girls to get on with revising etc, and get more questions I think - boys tend to work things out by themselves. Maybe girls might be a bit easier to teach? More diligent and you can tell them to get on with something and they will - but there are plenty of diligent kids here. Boys tend to find the answers and the ways of solving things by themselves. When I asked the kids at [*previous school*] to find and present on their own mathematics thing, then boys went and, by themselves, found a lot of different things, as mathematics was something they liked. - KM1

> I don't think they [boys] get more interested, no. I think it's the entrance exams. I mean, maths is interesting but you're not wanting to study it at home. Girls are anxious so they're studying and studying away. - M2.1

The impression given was that girls' approaches tended to protect them from being at the very bottom of the class, even if it would not make them great. This was made clear when teachers discussed the gender ratios of ability-streamed classes, or if they had ranked data available.

> [The ratio is] about the same……the very lowest there's a few more boys. That's because if anything…girls are diligent and steady. When you split them into the three, top/middle/low, those steadily working won't end up at the very bottom. - X4.2

TO.1, an experienced teacher in a mid-ranked private school, brought the data from the middle school's entrance exams to the interview – this data was split into performance ranks. He explained how girls tend to cluster in the middle ranks because "they work diligently", but that "there's only boys in the S rank" and that the split in the lowest rank is roughly even. He went on to describe how girls tended to do better at first but that this would shift in the future. This is a key point we will return to in Section 6.3.2.

Although teachers described girls as hard working, diligent, and steady workers – teachers did not consider this to be enough. Only one teacher, in the poorest performing school, mentioned practice alone. For everyone else, practice and revision were just prerequisites for developing the real skills that allow you to be good at mathematics. Practice, and being familiar with the basics, frees the mind up for thinking mathematically. This enables you to concentrate on the thinking process rather than the mechanics of how to get there. It was necessary, but not sufficient.

> Um…well…how do I put it…like pure calculation practice – that's not enough. The habit of thinking about it logically…that kind of thing…'if I change this how will the answer change' that kind of that kind of thought training. That's the real ideal, I think. - KHW

> I did *Kumon* questions...getting the kids used to numbers, you can really impact those skills on kids when they're young. Putting aside theory, first it's about training/drilling. Later, you can add in the logic, but you need the basics first. When you're solving questions there's all sorts of ways to go about it. 'There's this way of thinking, and this way, and that way"…you've got to look at all of them and try them out to solve questions. Like 'this works, but this one is quicker' etc. You need to be practicing to be able to do that - T.2

Practice still had to be the right kind of practice, with the right approach, and the goal was to develop the skills necessary (such as conceptualising power) that is a real key to being good at mathematics. Girls may be hard working and diligent students, but teachers only saw this carrying them part of the way there.

6.2.1.2 Mathematical Thinking/Application Ability

The importance of mathematical thinking - and the ability to apply that mathematical knowledge - was the biggest category of responses to the question of traits you need to get good grades in mathematics. Assimilating information learnt in class, and deeply internalising that knowledge, was considered vital for developing mathematical thinking and the ability to apply knowledge in new situations.

> Well, practice is important. But it's not just memorizing formulas…if you don't understand why something is happening [then] you can't solve application questions. Back in the day it was teaching formulas and being like 'Right. Use that' but now active learning has become a popular topic, getting the kids to think about 'why does this happen?' you do a lot of things like that, and then you go through the question and in the end 'ah there's this kind of law' or 'there's this formula' that's what we do. – Z14.2

> At our school, whether you do or don't review the lessons means a big gap in ability, I think. More than reading a textbook, 'it's what did I learn/study in today's class?'. It's good if the children can assimilate/digest [the information] in their own way, and become able to explain the meaning. So, our lessons are centred around making the kids think about various things branching on from what we've done before. If you don't clearly understand what we did before, you'll be unable to think about the next thing. So, it's not preparation, it's properly revising what we've done, making sure you've got that base of knowledge and then building on that for next time - that's what will improve your grades. - B1.1

Successful students were those who were flexible and responsive, trying many methods and approaches to solve mathematical problems. They can take their knowledge and apply it to new, harder, or unfamiliar situations.

> After that, if there's something that you don't understand then [having] the autonomy to try to solve it yourself…and then…I wonder…being able to generalize from a lot of different places – "we did addition before, but if I can't use addition to solve this problem then I should try out subtraction"…from lots of different places "I should try that out" -Z14.3

> Well, understanding how to/ways to think. In mathematics, when you have to think about a problem, 'there's this approach and this, and this' making sure you have lots of different choices. Even without knowing which solutions will work, in order trying out the ones that you think you can do 'if it's this approach then you do this, then that' or 'in this way then you do it like this' then you'll manage it in the end. And while you're doing that, you might have some calculation errors, but in those situations it's the thought process of what you have to do to solve, the important thing is whether you know the method. Well, if you do make a mistake you might not get the point but if you have that thought process, well, that's enough. - B2.1

Pupils should study 'why' things happen in mathematics, not just lean how to do a certain type of calculations. The ability to identify connections outside the mathematics covered in class – including being able to see links between topics, and even between other subjects. Teachers also emphasised independent thinking, being able to work through difficult problems on your own without resorting to outside help (at least at first).

> Like, from yourself…proactively, thinking very carefully about hard maths questions...You have to be, voluntarily, from you, that's really important I think. With middle and high school, you have to do lots of questions to improve. It's not about being told to 'do this and that' and lots of practice, it's got to come from you. Things like 'if I change this, then what happens here?' that's how you improve, I think. - KHW

> Amongst the good students there are those that don't carefully take notes… the ones who are good are those that look at it from lots of viewpoints like 'this method of solving is a good one'…On the other hand, poor students who just use methods taught by teachers only…and it doesn't go well. - SK3

Independence also extended to the related trait of endurance. To be good at mathematics, you should not give up (or ask for help) too quickly. Instead, you should exhaust your options using the above kinds of techniques before asking a teacher, peeking at the answers, or simply giving up. This kind of resilience was held up by many teachers as vital for getting good grades. This trait is also closely linked to confidence, covered in the next section.

The importance teachers place on mathematical thinking skills is not such good news for girls. From the previous chapter, we can see that these mathematical thinking skills are strongly associated with boys and identified by many teachers as missing in girls. Girls are described as less flexible with their thinking, and that they need things to be presented a certain way or they struggle.

> Grasping questions from a different angle, approaching a question from a different angle is something they're [girls] not good at. It would be weird to say that boys aren't diligent…but they can use different angles for the same problem and have that intuition…I haven't really thought that deeply about the differences between boys and girls. 'Because they're diligent they're inflexible' is the only thing I can think of. [Interviewer: so boys think more flexibly?] Yes. But that's something that only applies to the kids who are good at maths. At that top level. At that top level of performance, the boys are more flexible thinkers than the girls, that's the feeling I get. - BN3

> Boys are able to jump intuitively, girls have to properly, logically work through [it]……. [*later]* girls are said to be bad at thinking flexibly. In contrast, boys, even if, ordinarily, they look like they're not really properly participating in lessons…it seems like boys are strong at quickly switching their ways of thinking. - LND

Likewise, girls are described as struggling when it comes to applied mathematics questions –a major factor behind the PISA gap, according to teachers. Even in the classroom this is a trait observed by many teachers. We will return to this idea in section 6.2.2.

6.2.1.3 Confidence

The next most frequent response was confidence, and the behaviours associated with it. Teachers explicitly said that having confidence in yourself was vital, and much of this was in line with the concept of self-efficacy – the factor that OECD (2013) researchers flagged as having a particularly large impact on Japanese mathematics results in the PISA 2012 test.

> Having that experience of 'when a maths problem comes up and you're able to do it easily', that's important. That's the important thing, the way to improve your grades. That feeling of 'I've been able to solve it', 'I did it' if you have that then you'll be like 'let's give the next one a go'. If you can't do it, then…yeah. You need to make sure kids have that experience of 'I've done it'. In order to get that you have to make them practice a lot. That experience of solving an equation will become the effort that improves your grades. - B1.3

Returning to the requirement for practice, teachers explained that students should make sure that they have a strong base of skills (like calculation ability) to give them the confidence to tackle harder problems. It is still the confidence that teachers see as what is necessary for getting good grades, but the practice supports it.

> Calculation ability. The speed and accuracy if you can get that going - even while doing exercises and application questions. Then you can concentrate on the mental process of solving a problem - that is…calculating the thing you've thought through and say "how was that?". Think and in the time before you reach the answer, if you don't get it wrong you reach the answer, but even when the answer you get is incorrect it's generally not a problem with the calculations you can have confidence. - TO.1

Teachers also emphasised how other behaviours associated with confidence are the key to success. As mentioned in the previous section, grit (or endurance) was an especially prized quality: pupils wanting to be good at maths should not be deterred by setbacks, give up, or be worried about getting things wrong.

> Solving lots of questions. And then, even if it's a hard question, not being too hung up over a particular solution. Move the pen. Just do it. And then, even if you don't manage to solve it, if you have a go, even once, put some time into it. At the back of your mind, you'll be thinking about it. So 'there's this, and there's

> this' and 'well, this doesn't work. That doesn't work' while you're thinking these things you'll eventually get it I think. It'll suddenly come to you. In that way, for example, even if you can't do a question you really stick at it. Thinking about it, even if it takes a while…encountering various questions and really sticking with it. - T.2

> If you want to put it in cool Japanese then 'patience/endurance', endurance? Yeah……. Of course, it's really important to think inside your own head 'after this, how can I become able to answer the question?'. So, when that happens, I say to them 'please refrain from looking at the answers', even if you suddenly don't understand when you're in the middle of solving a question…five minutes…don't look at the answers so soon. Don't look at them after you've only been puzzled for a minute or two. Properly spend about ten minutes...and try it again, and if you're like 'ah, what should I do?….maybe like this? Or like this?' try lots of different ways of solving it, fail, and then if you're still like 'right, it's actually hopeless' then just a little look - just a little hint - think ' ah ok, I get it ' then close it again. Try again. Those kids who will do that will become able to do it, I think…….The kids who properly keep this [rule] are the ones who grow - SB1

> As in at school? Or in tests? For school well…well for both…if we're just talking about the tests then of course then it's about being able to solve problems, that's the most important thing, many different types of questions, thinking carefully/deliberately. Like, for me, when I was at middle school and there was a hard problem, like, I've spent more than an hour at home on a problem. Not thinking 'oh this is useless', otherwise you're not going to become able to do it. 'I'm definitely going to solve this problem' that kind of thinking is the important thing I think. [Interview: don't give up?] Yeah, not giving up. Sticking to it. That's the most important thing. - T.1

Being able to reflect on your mistakes and learn from them - rather than being deterred – was another advantage linked with confidence. This links back to classic self-efficacy building techniques such as the ability to interpret failure in a productive way.

> Thinking for yourself. Thinking for yourself and correcting your mistakes. When we're looking at how good and poor students study then…looking at the question paper…the bad students just put their answers in and that's it, with none of their thought process written. The kids who are good at it have comments and things and show changing thought process. Of course, practice is important and the kids who are good at maths are very probably doing lots of practice but whether you can accept and learn from your mistakes…understanding that change… - X4.2

It is easy to see how this operates symbiotically with the requirement for developing mathematical thinking ability; it allows the flexibility and experimentalism that is required to develop it. Indeed, a lack of confidence and the resulting disengagement with the test was another commonly hypothesised reason for the PISA gap from the teachers.

The requirement of confidence to get good grades is especially problematic for girls and represents possibly the clearest discrepancy between how teachers view girls and how teachers view the ideal student. Girls having lower confidence and being afraid or embarrassment or failure were defining traits of theirs for many teachers.

We saw in Chapter 5 that girls are often described as less assertive and less likely to raise a hand or call out to volunteer an answer. They were also described as more likely to ask questions when they were unsure, and that they were less likely to ask questions when they got stuck - teachers saw a lack of confidence reflected in both (seemingly contradictory) descriptions of girls. A term that popped up throughout interviews, and was only ever used when talking about girls, was *nigateishiki*: that girls themselves feel they are bad at mathematics. Teachers often described girls as having poor self-esteem and a sense that they were bad at mathematics. Teachers saw girls as more anxious and in need of reassurance, and some described how girls can be a little panicky when things seem to go wrong.

> Girls are anxious so they're studying and studying away. - M2.1

> Particularly girls, um, about the way they solve things…if they don't neatly get the numbers straight inside themselves when they go to solve [a question], they disengage. If they don't understand clearly then it's 'I don't understand this' there's a large number of students who will say this kind of thing. Boys, if I had to say something, have a tendency in my experience, to calmly answer a maths question like 'the answer must be this' without panicking. - LND

> They lack confidence, their sense (*nigateishiki)* that they're bad at maths is strong. – T.2

Teachers commented that girls need reassurance that they were on the right track and encouragement to trust their judgement. SB1 felt that boys need mathematics classes to be interesting, while girls need to feel secure because they are more anxious. This was also reflected in how they described boys and girls as needing different teaching styles – a recurring theme was that boys responded to challenge and more difficult questions whilst girls would shy away from them.

> It feels like boys have more of a challenge spirit. When I tell them to do a difficult problem, of course there are boys that give up - it's a personality thing - but that kind of stance of 'let's challenge ourselves' is stronger in boys. On the other hand, they get bored quicker. - TO.1

> Amongst girls, comparatively, more than average, there are girls who aren't good at it and don't have confidence…especially girls in the lower end, that's very striking. Giving them confidence…like I said earlier…giving lots of easier tests and building it from there. Small steps are a good idea. Comparatively, with boys, giving them suddenly harder questions 'I couldn't do it, but I'm going to try again' there's that kind of feeling. But with girls you don't want them to fail, so you slowly build them up. That feels like a better fit - SJP

A prevailing view of girls is that they are scared to take risks. According to teachers, girls are anxious about making mistakes – especially if this 'failure' is public, such as volunteering an answer. A conversation between two interviewees explains this dynamic: girls are more self-conscious, worry about being incorrect and therefore slowly stop putting themselves forward. Although boys may also experience this to some extent, teachers feel the effect is much more pronounced in female students and most easily visible over a period of time (such as moving through middle school years).

> 2: For me it's assertiveness. From the first years into third years, my students lose their assertiveness…my first years happily put their hands up - whether they're right or not. In third year, it's only really if they're right. I'm wondering if they're getting really self-conscious, you know. Being self-conscious…I think the girls are more so. It gets harder and harder for them to call out. Boys don't care. The kids at the top and the bottom alike, right? The boys who are good at studying, and not good at studying……But the girls are quieter and become unable to speak. I think that's the change. You don't say your own opinion…your thoughts might be different from others… they're just after the correct answer, so do exactly as the teacher says.

1: And 'What if I'm wrong?'

2: That's right. There's not many boys who think 'what if I'm wrong?!' Boys are like, even if they get it wrong and they get laughed at, they don't care. But girls *really* care. So they don't say [1: *agreeing*] So there's a really big difference.

1: They have opinions. I have them write it down on paper…….you get them to write it down on paper and boys and girls will both do that…*but* if you don't say to the girls ' that's right! ' then they won't come forward with it. 'Right, now you say it', that kind of thing, otherwise they won't share. – X4.1 and X4.2

…I have the impression that girls really don't like being wrong. That being wrong is terrifying/horrifying. Boys are more like 'even if I'm wrong, that's ok' . You could say that girls are cautious. - SK3

Many teachers painted a picture of shy, quiet, girls contrasted to confident boys. A couple of teachers even reported that boys will happily say 'I'm a genius'. Girls, however, tended to understate their achievements and were much less likely to show off.

There's more boys than girls who, when they solve a difficult question, are like 'I solved it! I want to show everybody'. Girls don't like to stand out. They don't want to say that they've solved a difficult problem. And that's because when they were young…I wonder…from when they were really young. It's not like 'this' is the cause [of the gender gaps] but girls are, if I had to say, more likely to downplay, while boys are more 'stand-out' – SH.2

[Interviewer: do girls have confidence?]

They don't seem to, no! Somehow…boys have confidence. For some reason. Positive thinking [laughs] 'I'm a genius '

[Interviewer: they say that?]

Yep!

[Interviewer: but girls don't?]

No. They don't. Why, I wonder…they can't say it because it's embarrassing? Yeah, they don't really say that. Boys are more…even if they're not particularly good - or not good [at all] – for some reason they have confidence.

[Interviewer: but girls?]

There's a lot with no confidence, even if they're good. - TO2.1

On the opposite end of the spectrum to 'genius' boys, many teachers described girls as having a poor evaluation of their own ability to do mathematics. They would lose confidence easily when they hit setbacks and would often be unconfident regardless of their actual ability.

> There's a lot of girls where they're good at all subjects, it's not like they're terrible at maths or anything, but their relative maths ability is lower so they think 'I'm bad at maths' they have ability but [*laughs*]. There's a lot of girls who have that feeling that they're not good at maths – Z14.5

> I think it's a confidence thing. Surprisingly, boys…with boys that's important is whether they'll challenge difficult questions or not, and girls even if they're doing progressively harder questions - if they can't do one then they immediately lose confidence. - SB1

> Yeah, if they have a problem they [girls] do [put their hands up]. In our school…if you're thinking about *our* school then yes, then the girls do put their hands up. But yeah, there are more boys who do. It's pretty fixed for who puts up their hands, probably - those girls that are good at it will put up their hands, who think its interesting, the girls will. With boys, whether they're particularly good at maths or not, or if they just think they are, then they'll put their hands up. – B1.3

6.2.1.4 Liking Mathematics.

Interviewees specified that liking mathematics, and finding it interesting, was a valuable trait although usually more as an auxiliary to the other factors discussed in this section. Teachers explained that enthusiasm and active participation is an asset for a child wanting to be good at mathematics.

> Whether it's boys or girls, whoever has interest tends to do better. - BN3

> That's such a hard question. When I'm teaching I get asked that. To get good at maths then the best thing is to like maths, to be honest. It's definitely the best thing you can do - be interested in maths. But for those who really hate maths, then I don't think there's any need to force it. That's a teachers' job anyway. But to be able to do it then, obviously, you need to practice a lot. Probably, it's good to teach kids that even if you hate maths it doesn't need to be hard. Like if you practice a lot then it doesn't have to be a problem. You get used to it if you do it a lot. – B1.3

> Liking it is the best thing, but there aren't really any kids who like it from the very start, so I'll increase the number of kids who can do the maths, increase their numbers, and instil confidence, so then they'll like it, so they'll want to do it, and get good grades. That's the flow. – TO2.1

This trait coming lower down the list should be good news for girls; few teachers think that girls were equally interested in mathematics as boys, and often contrasted boys' curiosity and engagement with the subject matter to girls' comparative uninterest.

> I think it's like 'if you're interested in something you can do it'…if you're interested. I think middle school girls aren't interested in maths. I mean they're interested in their grades but... - X4.2

> For the second years, especially at the moment, we've started on Proofs but…the ones who 'bite' properly, who show interest in that, there's more boys I feel, I feel that quite clearly… - SJP

> Ultimately, I think if you're looking at the bigger picture, then boys are more interested. Even in boring classes, it's a feeling 'together we'll do our best to solve maths' – there's more boys, I think. - SK3

A number of teachers used the word 'bite' (*kuitsuki)*, which here we also translate as 'taking the bait' or 'sinking their teeth into', whilst others described similar behaviour without this word. Boys, in this view, are enticed into mathematics study by particularly interesting topics, challenging questions, and have an interest in the mechanics of mathematics itself. No teacher ever used language like this to describe girls.

However, it is strange that this trait comes so far down the list especially as girls disliking mathematics was the second most common explanation for why the PISA gap was so large, put forward by two thirds of interviewees. The reasons why this might be the case will become clearer in the next chapter. Even so, we can see here that an affinity for, and enjoyment of, mathematics is also linked to other characteristics like the development of mathematical thinking

and confidence. The subject of girls' interest in mathematics (and what form this takes) will be revisited in the Chapter 7.

6.2.2.5 Talent

When asked about the prerequisites for getting good grades in mathematics, teachers tended not to (although some did) explicitly use the words 'ability' or 'talent'. However, there were references to mathematics being a matter of 'inspiration' and innovation, and that an intuition for the subject is a boon.

> Hmm…continuous study…Well the number one thing is ability, there's kids here who don't do that much but they're really good at it, but of course in it's own way…if you've got normal levels of ability then it's continuous study. I think that maths is the most time consuming, and that kind of continuous study takes up a lot of time. Things like if you get something wrong along the way you have to go back, revisit it, then carry on – that kind of thing. And if you don't do it every day then the normal kids won't get it. But there's 'ah they're smart kids' who don't really do that and [still] do well. – SH.1

> 'Mathematical brilliance' that kind of thing…again, this is my bias, but that's something boys often surpass girls in. The ones who are diligent, trying their best to tackle their work…that's girls. It's not just ability it's a sense/intuition. It's not that girls are inflexible but…but for some reason the impression I get is there aren't many [girls] like that. - BN3

From the literature, we would expect teachers to put a lesser emphasis on ability/talent than on effort (Stevenson et al. 1986; Holloway 1988) which would certainly be a positive finding for female students, as teachers did not describe girls as having a natural talent for mathematics. However, there are ways of implying it without using the exact words. When we pull back and look at how teachers explain the performance differences between boys and girls in general – or specifically concerning causes of the PISA gap - that discussion of ability is more prominent.

Many teachers described boys having stronger comprehension and conceptualising ability, the ability to make mental 'jumps', having a 'flair' for mathematics, or even just being better at the subject.

> [Boys'] ability is higher, generally higher isn't it? Well, there's all sorts of children, but in general there's that tendency. A tendency - T.1

> Biases are probably mixed up in this [opinion] too but…and the reality might be totally different, but…so teaching mathematics, when it comes to hard questions, 'flashes' when solving hard questions, or things that need intuition or a kind of sense...honestly, I feel like boys are higher [in ability] with that kind of thing. I would be teaching mathematics and set a hard question and then think 'how will you solve [this difficult question]' those solving it with flashes of insight was more boys. The girls with that kind of spark of intuition…there aren't many of them, that's my feeling. That's probably my own biases, I don't know if it's true but… - BN3

> I don't think that it's about men or women. Kids that like something will do it for you, that's the feeling I have. In terms of conceptualising ability…boys are more sudden…that's my personal opinion. - B2.2

It did not even have to be an explicit statement. Occasionally, teachers even gently conflated 'boys' and 'kid who is good at mathematics'.

> [Streaming] is better. As of next year, this school will be streaming in maths, so we're thinking about that. Partly the reason is that it's easier to teach the upper portion and lower portion separately. In the upper group there are also girls who can cope with the hands-off style of teaching. But, if it's a really neat/careful lesson then the boys will get bored…but for the kids who can't do maths you have to do it carefully. For the kids who are good at it you can be hands-off and then progressively talk about harder things, and they'll sink their teeth into problems, chase and chase after them - that kind of stance boys…well, kids who are good at maths, they have that. So, ability streaming is spreading in Japan. - TO.1

> When they become third years they're divided into *rikei* and *bunkei*…the students who go onto *rikei*, with maths as that centre, first of all, they're mostly boys. And the students who are not so good at maths, who don't go onto rikei, they're mostly girls. So, you can clearly see that ratio in terms of numbers… - BH.Y

What teachers would count as talent and ability is something to consider. It does not seem like a concept that can be completely de-coupled from behaviours and attitudes; the distinction between an innate kind of ability, and the kinds of ability that you (theoretically) can develop is also in play here. We will explore this further in Section 6.3.3 and 6.4.

Summary

In this section teachers emphasise mostly those traits found in Theme 1 (personality) such as confidence and resilience and Theme 3 (ability) such as affinity for the subject and mathematical thinking. We also see the traits discussed here in this section bleed into each other, depend on each other, and interact. The picture that teachers paint of girls collectively does not match up well with how teachers describe what you need to get good grades in mathematics. Although these two descriptions do not line up, we saw in chapter 5 that most teachers said they did not see a grade difference between their pupils (at least initially). Did teachers give answers that go above and beyond what you need for good grades themselves? Did they describe girls 'wrong'? In the next section we take a look at what might be happening to produce this contradiction.

6.2.2 Classroom Mathematics vs 'Real-World' Mathematics

Thus far in Section 6.2 we have discovered that teachers see girls one way, and that they see the ideal mathematics pupil another. But, if that is the case, we must investigate why so many teachers would state initially that there is no achievement gender gap. This section will discuss the concept that teachers view different kinds of mathematics differently.

In Chapter 5 we saw that one of the most common achievement differences reported by teachers (along with the change over time) was that girls struggle with questions involving certain areas of mathematics. Often, girls did worse with those involving spatial awareness, and did better with pure (or more straightforward) aspects like algebra.

> During lessons I don't really feel a big difference but, depending on the year, 'boys are better'/'girls are better'…I've thought that. In general, 3D shapes…girls are not as good at that…I've heard that in general conversation and maybe it's my subjective assumption because of that, but, I do think I agree. In reality, when we're doing 3D shapes in class the boys are more able. – SJP

> You know, comparatively, girls are better at doing equations. As they go up the school, I don't know the reason why, but girls don't really…visualise shape/space. Like, even if they've got a map they can't walk [laughs] Perhaps...I don't know though…men and women have slightly different brains, maybe. So,

> with those differences in mind take different approaches - what those processes are, well, that's something that teachers have to work out. - M1.3

> It's not necessarily limited to 'boys are better'…how do I put it…For example in geometry, girls are not so good at geometry…drawing shapes and things like 3D shapes… 'Boys' spatial awareness is high', is said a lot. With women, they're better at algebra or algorithms and things like that. That's maybe related to our genes going way back [laughs] - WS1

Many teachers (and researchers) drew a line between different types of mathematics for different purposes. They felt that female pupils tended to be better at 'textbook' mathematics - things covered directly during class - rather than unfamiliar questions or situations that would require them to apply that knowledge[3].

> For example, normal equations or questions like ones you'd find in a textbook, if you do those diligently then you can get them. But if that's not the case then it's [down to] thinking power so, in that case boys are stronger in that part. T.1

> Therefore, in those regular tests – the ones with set boundaries to revise – in those girls work extremely hard so they get good grades. So, in tests where there's no set part to revise…so proficiency tests etc, in those boys are stronger. Therefore, comparatively flashes [of genius]…boys are strong at that. Girls aren't like that, there's lots of girls who properly display/demonstrate the stuff they've studied that they've been taught. - T.1

> I wonder…girls are higher? [Interviewer: No. Boys are] boys are higher? That makes sense…From the standpoint of everyday life, solving problems, puzzles etc, and the awareness of using it [maths] is stronger. Girls are better at understanding and acquisition of basic/fundamental knowledge, but using the stuff they've been taught?…boys are better. – B2.3

> So mathematical ability and test taking ability are completely different, you know. Going to *juku* and things, it's not : 'getting good grades equals good at maths' being able to do the questions in textbooks is just that. Things you don't understand you yourself, personally, finding the problem and your ability to

[3] Interestingly, Riddell (1989, p.13) had a quote from interviewing teachers in the UK which echo these views verbatim. That if it was mathematics that needed a "routine approach" where girls just copied the teacher then girls do well. Otherwise, "where a bit of flair is needed, then I think the boys have an edge"

> solve it as one part of mathematical ability. That's something that boys are definitely better at. - NA1

Girls can reproduce what they have been taught, but they are less able to apply this knowledge. Under these conditions, some teachers mused that girls would suffer if the amount of applied content in the curriculum was increased.

> So with the kids I've been teaching up till now, including the ones I'm teaching this year, even if you'd give them those same questions [*like PISA]* - I would imagine there would be a lot of resistance from the girls to those questions...I think there are a lot questions that come out in the concrete everyday life setting. However, if you link those questions up with real everyday life then... things like parachutes and hovercrafts...those are things that girls have more of a resistance to in real life too. - LND

> It's a different thing…so with maths tests, there are also questions for mathematical ability but…most [questions] are for foundational calculations and things you have to remember, that's more than half, while application questions – where you have to look at with mathematical ability - is about 30% …and if that was more the focus then I think the number of kids who wouldn't be able to solve those would increase. I have that impression. Like, kids who weren't properly able to do the foundational stuff they had covered previously then they wouldn't make it – I think there's a lot of those kids. Their inventiveness/conceptualising power doesn't come out, that's more girls who are unable to do that – Z14.6

Teachers clearly articulated that there was a difference between being good at mathematics - having a real command of the subject matter and the ability to use it in new and unfamiliar contexts- and doing well in school by getting good grades on a homework assignment or a progress quiz.

In the last section we saw how much importance teachers placed on mathematical thinking, but here we see teachers drawing an explicit connection between girls' weakness in these skills and their lower performance in a certain kind of mathematics. This becomes clearer still when a number of teachers said that girls do well at the middle school level (or early middle school and elementary school) because of their approaches to schoolwork, but that their strategy would not work for much longer as the content becomes more complex and the pace quickens. Skills and

approaches that could carry you through these earlier stages of mathematics class would not be enough at later, more advanced, levels.

> It's the kind of subject where it's either right or wrong so...from high school onwards maths is about your way of thinking, so even if you can get the grades when you're at middle school, whether you'll get points or not for answers at that level is... - LND

> With the level we're teaching at in middle school…If you're neatly, diligently, seriously studying, [and] you put your power into it then the results come, I think. So within that kind of approach…so with that I think at the moment 'girls are higher' is the feeling I have. So…… So perhaps there is a gap but 'they're being diligent' and at this level it compensates for anything, I think…So, with learning, as it becomes a steadily higher and higher level, perhaps…then boys are more…well I think, different areas too…more suddenly be able to solve it…that's not really an answer I guess… -T.2

This is very visible when teachers were asked for their theories as to why the gender gap in PISA existed. The second most common hypothesis from teachers was that the high level of application content in the test would disadvantage girls. For others, the unfamiliarity of the PISA questions alone would have caused the female students' problems.

> I wonder…That there's a such a large gender gap, I thought 'ah, yeah sure'. That boys are higher, right? And girls are lower? [Interviewer: yes] Yeah, I can understand that. The PISA tests are totally different from our exam questions, I get the feeling that they're quite unusual. I can accept boys getting better grades in that. That's because boys have a lot of different ways of thinking and expressing things - like we were saying earlier. I'm guessing that's because girls get good at doing the stuff they do in class, and then if you compare that to the OECD tests it's [the questions are] a bit different so they become unable to do it. Rather, if girls were *better* able to do it then I'd think that was strange. - X4.2

> I think the gender gap is really interesting. Like with easy school tests, girls will get better test scores. They do. Simple tests, simple lessons, the sorts of problems set in class they can do. But when it comes to hard problems, that changes I think. That's why, boys will from a lot of different perspectives…like whether it's a brain structure thing or…with girls they're being girly or…it's that kind of thing. SK3

> I think it is, right? Such large gaps don't appear in school tests but probably, when it comes to thinking ability and judgement ability in maths -like I said

> earlier- more boys really drill down into it…but that kind of thinking ability is of course, that's going to come out in the PISA tests. So, to a degree, it's bang-on. NA1

Exactly why this might be the case varied, from those who felt it was more about girls' relative lack of confidence, to those who thought that girls would get 'stuck' in their thinking.

> Well…looking at it as a whole, that boys do better than girls at maths, I can accept that. Female students think they're bad at it more strongly and have lower self-belief. And girls struggle with questions that they're seeing for the first time…boys might well have better application ability. -Z14.6

> Well with the PISA tests…comparatively it's less about what you've learnt and more about using what you've got internally to think about it and solve the question. So boys would be better at that I think. Comparatively, the National Tests…at the moment the test reflects what Japan wants at the moment…so the base is the stuff that's in textbooks and there's not much included that strays away from that. So in that sense…a gender gap would emerge. So what I mean is the girls wouldn't be that far off with that, but with the PISA tests it feels like more of a difference would emerge. SJP

Teachers have not only drawn a line between 'classroom' mathematics and 'applied mathematics', but they also describe girls and boys as coming down on opposite sides of the divide. This is an opinion shared by several of the researchers too.

> But it's not that they [girls] can't understand it. It's that, if it's a test where the scope is limited to revision, you probably know in Japan there's things like midterm tests and end of term tests and things. With those, girls aren't getting low grades. Things with limited parameters, the things they've learnt, the things they've revised and learnt there isn't a gap at all. – KG.R (Researcher)

This also circles back to the differences between PISA and TIMSS discussed during the opening chapters of this thesis: that the former's achievement disparity was wider and focused on application of mathematical knowledge, while the latter had a smaller gap on a test which evaluates students' command of their curriculum.

6.2.2.1 'Good Girls Don't Get Ahead'?

We can gather from the preceding section that teachers view 'classroom mathematics' and 'applied mathematics' differently, and that (collectively) girls are viewed as good at one and not the other. How teachers explain *why* this is the case is crucial for understanding how they conceptualise the gender gaps and exemplifies the first way that the gender gaps in mathematics can remain unproblematised. Girls' are working hard, but boys are working smart. The 'Good Girls Don't Get Ahead' (GGDGA) view is that girls' temperament and approach to their mathematics study is not conducive for being good at it – but the tone of how this is described does not place the 'blame' on girls themselves. It is nobody's fault; it is just how it is. This contrasts with the other major view we examine in Chapter 7, drawing on Themes 2&4 (interest & talent), which flips this idea on its head and puts the locus of control with girls.

> [Interviewer: ever discussed gender with colleagues?] I have. 'Generally, boys are better at [maths] aren't they?' 'Girls try harder, but there's lots who are bad at it' 'Boys are quicker, unsurprisingly' 'they simply, logically, properly are able to write their answers' and 'girls are scattered, there's lots of different thoughts in there' – we've discussed this kind of thing. – TO2.1

> Yes, for the entrance exams. Even though girls are working their hardest, in the end it's the boys who are rewarded. That's just maths though, for example with English then that diligence pays off for girls. – TO.1

> If we're talking kids with around the same level of mathematics ability then it's girls who have a perception that 'I'm bad at maths'. But they put a lot of effort in to compensate for that, but they get around the same grades as boys. – Z14.6

Teachers view girls as hard working, describing them as 'diligent', 'working steadily', and being careful and neat with their work – terms almost exclusively only used for girls. However, here teachers say that hard work is not paying off and the effort they perceive girls putting in is not proportional to their outcome.

Some teachers, such as SB1, theorise that girls' effort is misplaced; their diligence and well-behaved, organised approach to schoolwork means that they focus more on completing their work than taking the time to do it to a deeper standard.

> One of the differences between boys and girls is...for example girls, when I say "please do the 10 pages" of homework, then...doing those 10 pages is what's important, because they're diligent. If they do that, like I was saying earlier, when they're solving things and their hand stops...I think they look pretty quickly [at the answers]. Right away, 'I need to do 10 pages' 'that's something I need to do'…without really spending much time on it question by question, they think 'ah, now I can't do it' [so] then they look - think 'ah ok' - and then do it. They might be able to do simple questions better than boys, but in the end because they're not going through it question-by-question and really internalising/understanding those questions. When they come across a slightly harder problem, then, compared to boys... - well boys aren't really, like if you're like "do the assignment" it's not like all of them will do it but, boys are probably more...when their hand stops, they'll thoroughly think through it without looking quickly. -SB1

> Like, if there's an answer in the back they'll [girls] look at it and write that rather than thinking about it themselves carefully…that's a characteristic more of girls really. [Interviewer: and boys?] They think about it deeply. That's the tendency in general yes, I think. - T.1

Rather than taking an approach that allows them to develop an understanding of the mathematics at a deeper level, and therefore improving their ability to think mathematically and apply this knowledge elsewhere, girls focus on completing their work and employ strategies that hinder this development. If girls become frustrated with their progress then they look at the answers to help them complete their work, whilst boys are more comfortable taking more time on a problem and place less importance on simply completing the work. Key to this perception of girls is the idea that it is *because* they are hardworking and diligent that this ends up working against them and ultimately weakening their understanding.

> Girls...yeah, boys are better at this endurance power. Conversely, when they don't look at the answers [too] soon, girls, unsurprisingly, do it well. But,

> obviously, a diligent girl is going to have lots of things she needs to do, and precisely because of this she's not spending loads of time on this. -SB1

> Well, girls have a higher rate of giving it in/submission percentage wise. But persisting…like *really* doing something to a deep level…there's more boys, I think. Girls are more about neatly summarising, like, if there's something like a report then there's a lot of girls who emphasise neatly wrapping things up. There's boys who want to neatly summarise too, but linking/associating with unrelated things, thinking more, and digging down more and more deeply? I get the feeling there's more boys like that. -NA1

> Boys are…sloppy…with their notes and their workbooks. So, in that way, at the middle school level, I wonder if there's a difference in grades…like looking at average scores the girls who are properly doing it at the present time it's high I think. However, amongst the boys, there's sloppy kids, but the ones who are persevering right till the very end and deducing those results – there's more boys who have that power. Investigating thoroughly, getting to the bottom of things…to that extent...there's comparatively more boys who are like that…… Well, there's girls who are like that too. But, um, even if they do it sloppily, the ones who will do that right until the end, even if it's a hard question, who really, really stick at it? There's more boys. - T.2

Teachers say girls are quicker to seek help, ask for it more often, and/or required more reassurance than boys. Where girls tend to give up, and look at answers too quickly, this means girls do not allow themselves enough time to work things out on their own. Girls want to get good grades and this translates into this kind of cautious behaviour which does not develop their mathematical thinking.

> I feel like boys think more freely. Girls search for the right answer, boys are more free with their calling out. It might seem sloppy, but it's actually pretty interesting. I have the image that boys will outspokenly call out, while girls aren't like that. It's like 'I mustn't be wrong!' so they'll [girls] carefully write down what the teacher has written, so even with the same question there's not much expression going on. Boys' ideas/expression are plentiful. – X4.2

> Saying 'I can't do it' and asking me questions, that's the girls – maybe it's connected to them steadily working, but there are more girls who say 'I can't do it' and ask me questions. – B2.2

> because…of course…I think girls hate to lose - they want to win. Wanting to gain knowledge, to understand more, it's not that feeling. It's 'ah, I'll wait for

> someone to teach me' for example, they won't put their hand up, "if I wait, the answer will just plop down", I think there's a lot of girls like that. - M1.2

> To me, boys study more because they're interested "that's interesting so I'll do it" or "that's not interesting so I won't". Without exception. But girls are generally after getting high grades and then they think that maths isn't a subject where they can get those high grades, so end up hating it. - B1.3

The approaches that teachers feel girls take, and the personality traits they associate them with, are not geared towards developing mathematical thinking ability and assimilating knowledge deeply. Rather, it is sufficient for getting good grades but not for being good at mathematics itself. Worse, when the complexity increases, or the type of mathematics shifts (i.e. into abstract or applied), these strategies may not be enough. For example, the switch from arithmetic to mathematics during middle school, or the spike in difficulty represented by high school mathematics, can leave girls struggling when in the past they had no problem. Some teachers noted that female pupils became disheartened when this happened, and many more noticed confidence levels dropping over time.

> Probably, girls are more…at the start, of course there's differences in ability but, but as you go up the system the girls feel more 'down' about maths…the lower ranked kids do. They're gradually working their hardest and they're keeping up… but the ones that end up not being able to keep up, thinking about my current year group, there's more girls. The boys who aren't good at maths were always bad at maths and are making efforts within that, they were always like that. But with the girls in 1st year they weren't… - X4.1

> Well, the material in high school gets considerably harder so I hear a lot of 'but I could do it in middle school!' - KHW

> Yes, that's true. Of course, there's a lot of girls who find they're bad at the shape/space questions, or that 'proofs' are difficult…whereby you have to logically explain what's happening and if you don't have the base then you can't express that…….when the girls are writing their own thoughts they don't seem to be confident and the frequency of them saying things like 'this is probably wrong, but' or 'this is a bit vague but' increases. In middle school that's not quite such a problem, they still call out a lot. So, the difficulty of the material and them growing up… being self-conscious…it's much stricter. – BH.Y

The trigger point for when this would happen varied according to the teacher – some talked about the pivotal moment occurring during the second or third year of middle school, others saw it as happening during the crossover to high school, and more still towards the end of high school (which we will concentrate more on in the next chapter).

6.2.3 Summary

Section 6.2 introduces a few fundamental concepts: that teachers see a difference between mathematics proper and 'textbook' mathematics for the classroom, and that teachers' see the traits of the ideal mathematics students and the traits of girls as very different. Moreover, teachers do have an awareness of these factors; we have seen how many teachers described how girls' behaviours and temperament gets in the way of them developing the skills necessary for complex or applied mathematics. A very common explanator from teachers for why the achievement disparity was so large was the applied and unseen nature of the PISA tests.

When the interviewees describe their ideal mathematics student, knowingly or not, this is a description that best fits a male student. Walden & Walkerdine (1985) found the same phenomena in the UK, noting that teachers' evaluations of students' abilities (including who was their best student etc.) bore little relation to the reality of differences between their male and female students. Instead, they say, teachers saw girls' success as coming from a different place than that of boys'. In this view, teachers valued the way girls do things less and therefore downplayed their achievements. Likewise, in other international literature, teachers are documented as attributing boys' successes in mathematics to talent or ability, and girls' success due to effort (Fennema et al. 1990; Espinoza et al. 2014).

It is certainly true there is a difference between teachers' descriptions of their 'ideal pupil' and 'girls', and that they feel there are implications for this on the real world of mathematics

beyond a strictly curriculum-based context. However, this does not feel like the whole story when it comes to our Japanese teachers, and it does not fully fit the facts of how they have described girls. A few teachers did conflate boys with 'pupils who are good at mathematics', and there was an undercurrent through several others' interviews that girls (and the way they did things) were boring or irritating (or, in a milder form, less relatable[4]). However, for the majority, there seemed to be clear respect for how dedicated their female pupils were and an appreciation that their methods worked (often very) well – if only under certain parameters. Teachers in this sample recognised that girls did work very hard (diligent, steady, careful, neat) but that this was just not always enough. In the rest of this chapter, we will explore this complex mix of respect and reproach, and what impact this is likely having on the conceptualisation -and therefore the problematisation – of the gender gaps in mathematics.

We still have not resolved the inherent contradiction between what we have learnt so far in this chapter, and the gut reaction of so many teachers that there was no achievement difference between boys and girls…or even that those teachers who did not have that reaction but still did not particularly notice (and certainly did not problematise) the gender gap. However, we now have what we need to start unpicking this web over the next sections.

In Section 6.3, we introduce the barriers underlying why the achievement gender gap has not been noticed or problematised; two of which draw upon what we have seen so far. In Section 6.4 we will expand upon the third major obstacle.

6.3 Invisible? Unproblematisable?

Teachers were asked what traits you need to get good grades; even then girls did not measure up. Things became clearer as teachers draw a line between getting decent grades by going through the motions, and actually getting good at mathematics - and that there were

[4] See section 7.5.3 in Chapter 7 for more.

different skillsets associated with each. Likewise, this maps onto how they discussed the difference between applied or advanced mathematics, and 'textbook' or curriculum focused mathematics.

Teachers also do not describe girls in the same terms as they do their ideal pupil (which is closer to their description of male pupils); and many teachers seemed to feel that female students' temperaments and skills were not a good fit for certain kinds of mathematics. All this has implications for how teachers conceptualise gender gaps and, therefore, whether they can be problematised. We saw that these kinds of views form a large part of how teachers explain the PISA gender gap.

If teachers are aware of this difference between their ideal pupil and girls, why is there no problematisation? Why did so many teachers respond initially by saying that they did not think boys did better than girls? In Chapter 5, we saw that there was a considerable disparity between how a majority of teachers (65%) initially said they saw no gender achievement differences in their own classrooms, and the 84% who did actually report them – a total that does not even include those teachers who had seen gaps elsewhere, or who guessed the PISA data correctly. And why has there been no problematisation even from those teachers who did not have that gut reaction. This mystery is indicative of the way teachers seem to be conceptualising gender gaps in the first place. In the next section we will look at several factors which help us understand these views.

6.3.1 Credentialism

Differing views of what counts as a gender gap is one easy explanation for why so many teachers stated initially that there were no achievement differences. Depending on the definition of a gender gap, which depends on certain metrics of achievement, there may or may not be one. This section posits that the credentialist pressures teachers operate under can disappear the gender achievement gap.

Classwork, homework, and termly progress tests are some of the most accessible metrics available to teachers, and these are important data for evaluating students' performance in their own classrooms. If teachers use this very visible measure, then girls could be doing at least as well as (or better) than boys. When thinking about their answer, it is possible that many teachers prioritised classwork or progress test results; if girls were doing ok in those tests, then they may well not feel there is a gap.

There are teachers who remarked that female pupils have good (or even better) grades because they are diligent and careful with their work; and that this kind of approach can work well in the earlier stages of school. That this observation usually comes with a caveat, explanation, or comparison to boys does not change the basic fact of teachers seeing girls doing well and saying so in their initial statements. We will explore some of these over the next few sections.

> At the middle school level I think there's a serious one [gap]. Because they can do it calmly, girls are more…because of that… of course, they can calmly do it. And moreover, there's a lot who will follow the set path for how to do things. If boys find something a pain they won't do it [laughs] the stuff they want to do they're doing it like "yeah!', but looking at the kids as a whole I'd say the girls have gotten better on the whole. - TO2.2

> But, like, amongst them, diligently trying their very best to tackle something, making that effort…of course girls are, proportionally, more of them. You see that in test results and things like that, I think. - T.2

This view would fit with what we have seen earlier in this chapter: teachers see a difference between classroom/test mathematics and applied or 'outside world' mathematics. We have also seen that many teachers think girls do fine with mathematics of the former kind, even if the approach girls take cannot make them truly good at mathematics. There is a strong possibility that teachers, understandably, base their initial reactions off whether they think there are achievement gaps in these progress tests or similar measures of classroom work. Indeed, if teachers did have data on hand during the interview then it was from these progress tests

(although these particular teachers had generally not had the 'no achievement differences' reaction).

It is true that making sure their pupils get good results (or good *enough* – a crucial point we return to in Chapter 7) is arguably the most important part of a teacher's job. A focus on concrete class test results might well be prioritised over other types of achievement that teachers discussed in the last section. In the literature review we saw that there has been huge pressure put on children to get the best grades for competition in a credentialist society (Kariya 2010; Kariya 2018). It would be understandable if teachers also felt this pressure and that this translated into prioritising test-oriented metrics.

Teachers make a distinction between classwork and more advanced or applied mathematics, and we have seen from the literature that there is a difference in magnitude between the gaps of TIMSS and PISA tests which mirror these. If certain teachers are using measures like class tests then they may well not be seeing a large (or even any) gaps. It would, therefore, be very difficult to problematise something that does not seem to exist. We will revisit this credentialism from a different angle in the next chapter, but before that we should consider whether these teachers might be operating with incomplete information.

There is a catch to the idea that teachers do not recognise or problematise gender gaps because they see no (or only a small) gap in class tests: very few teachers actually knew these raw scores divided by sex for sure. Almost every interviewee was answering from memory, and their overall impressions of these scores, rather than directly from the data. A few teachers did either bring, or left to go and get, this data and consulted it during the interview. In one case, when asked for specifics about the achievement gaps, a teacher hesitated and went to check the records. What he found lined up perfectly with what we would expect from the literature: that boys overtake girls during their time in middle school – even in classwork tests.

> Ahh, is it ok if I go look at the data? [*pause while he checks*] Ok, so I just took a look. The pure data is, the test scores, in first year the girls get 1 or 2 points

> higher. In 1st year of middle school. And when they become third years, the boys are getting 3 or 4 points higher. So, between first and third year it reverses. The scores do…yeah. - B2.1

The teachers who did bring data with them had brought progress test results, and they were not generally in the group who said there was no gender gap at the beginning of their interview. However, most teachers did not have this data to hand, so it would make sense that their views were impacted by the data they had available. The (un)availability of this information is partly determined by outside pressures - which we will explore in Chapter 8 – but teachers and schools could get hold of it if they wanted. We examine this in the next section.

However, it feels unfair and inaccurate to say that teachers are responding solely to credentialism for their answers. The impression given by the vast majority of teachers was that they cared deeply about their pupils and saw their role as more than just getting exam results out of them; whether it was wanting pupils to have confidence in their abilities, enjoy and take an interest in mathematics itself, or seeing their role as different from a business like a *juku.* We will understand more of this reasoning in Chapter 7 when we look at the *bunkei/rikei* system and its impact.

> Like for me there's some very good students, students I want to have more confidence and I want them to say 'the subject I'm good at is maths'…- Z14.3

> The maths ability I want to impart is…thinking a lot during classes, and getting them to share their opinions…that's more important I think for the big picture. - SJP

> *Juku* is boring because it's doing stuff you know - but it's easy, so you can get better at it. So, like in the old days, I've been reflecting that we need to draw out that learning interest more, even if it's not a lesson' but be like "this is interesting' 'those curious, please try', with everyone with different level problems to draw them in. – M1.2

Credentialism cannot be the whole answer, especially as there were teachers who said there were gender gaps from the beginning of the interview, and especially as there might actually be

gender gaps even in classwork grades according to both the literature and the interviewees (Isa and Chinen 2014; Uchida and Mori 2016). This too will become clearer in the next section.

6.3.2 Perceptions and 'Lenses'

Some metrics may be more visible than others, but it still presumes that anyone is looking. It also depends on *how* they are looking. Many (but not all) teachers do not seem consciously aware of the gender gaps as being gender gaps - even though we have determined that teachers have a wealth of latent knowledge about gender disparities and their implications. You cannot problematise something of which you are not actively aware.

To probe how teachers can be both highly knowledgeable about the conditions, but not register them as gender gaps, we will examine how one of the most reported patterns of achievement differences can easily remain unseen: change over time. Which perspectives, angles or 'lenses' teachers use to examine their own classrooms affects how visible the gender gaps are and, therefore, whether they are problematised. One such angle teachers were asked to consider is 'change over time', but teachers must simultaneously consider this from a gender perspective as well to reveal the gender disparity.

Teachers generally had responsibility for a certain year group (or ability streamed classes within these), and rarely taught all year groups at the same time. Which classes they held responsibility for seemed to change every academic year, meaning that the current 'view' available to teachers could represent children at very different stages in their school career. This matters as we find teachers perceive the achievement gender gap widening (or reversing) as children move through the school system; a pattern we also see in the literature examined earlier in this thesis.

There were teachers (such as SB1 and SK3) for whom 'change over time' was already salient, and they brought this up as a gender difference from the very beginning. For them, looking through both the 'gender' and the 'change' lenses simultaneously was automatic and the way

they chose to explain what they saw going on in their classrooms. A larger proportion of teachers, also understandably, based their initial answers mostly off their current students and considering the class in isolation. It was not until they were asked to compare year groups, and to do so keeping gender in mind, that they described exactly the same pattern of widening or reversing gender disparities in mathematics – complete with the same kinds of explanations as to why this would be the case.

If it is necessary to look at the situation from both the 'gender' and 'change over time' perspectives, using both lenses simultaneously, to see the gender disparity then what happens if teachers are discouraged or hindered from using the lens of gender? Two of the older teachers, WS1 and SH1 commented that it used to be normal to split (or have access to) data on performance by sex, but that this is no longer common practice and teachers are less likely to compile this information themselves[5]. If there is nothing drawing attention to gender, and certainly nothing drawing attention to it in combination with 'change over time', then that is one way the gaps can remain unproblematised: they are not 'seen' at all. We will return to the factors that are likely influencing this attitude to gender (purposeful or not) in Chapter 8 when we look at ideas of gender blindness and taboo and the stifling effect this has on discussions of gender.

6.3.2.1 Other Explanations Block Problematisation

Even if a teacher does notice a change over time (and that it is gendered), there are ways to explain the pattern away. With the mystery 'solved', there is no problematisation. The same can be applied to other gender differences, but we will again concentrate on 'change over time' to illustrate this.

6.3.2.1.1 Entrance Exams

A common explanation for why the 'change over time' pattern occurs is the influence of High School (or University) entrance exams. According to many teachers, looming entrance exams

[5] See Section 8.2.3.2 in Chapter 8

cause boys to start working hard(er), meaning that they will either catch up with girls or that they will overtake. While girls are thought of as hard working and dedicated all the way through their school career, boys are often described as being lazy or unmotivated for much of their time at school. Teachers explained that entrance exams mean that boys 'wake up' to the need for them to work hard, and this burst of attention and dedication means that they will close (and often reverse) the achievement gender gaps.

> Ah…well at this school…the ones who have just entered the school, the first years... Well, at that start, there's not a lot [of difference]. The standard for entrance exams for the girls is higher[6], girls -not just in maths, all of the subjects- get good grades. However, when they become third years, for some reason, with maths, boys catch up and over take - that's how I feel. I wonder why…well firstly it's entrance exams, they're studying for entrance exams…another one is probably…boys take the bait/bite. Boys are more likely to want to solve interesting problems. Particularly entrance exam study, for most it's a pain, but for boys 'if it's maths, then because it's interesting I'll do it'. There's also competition: There's not many boys here, but even though there's only a few they feel like a larger number. -M2.2

> There isn't really a gender grades gap…but…if I think about it by year then it's a bit wider by second year. Like, with attitudes, becoming a second year you start thinking about which high school you want to go to…the number of kids who are serious increases. – Z14.2

> Grades? Up until about the first/second year of middle school, there's a lot of times when girls will do better. Boys, up until about the third year of middle school, they don't really do a lot of studying. After that there's the entrance exams for high school, so suddenly they seriously start working. - SK3

A modified version of this applies to when teachers talk about what happens during the later years of high school. The next chapter will focus on the *bunkei/rikei* split and its effect, but here we will say that this is another perspective that many teachers use to understand the 'change over time' pattern. However, not all teachers used this explanation for this age group. One

[6] This school is attached to an all-girls high school. Teachers said competition to get *into* the middle school is likely to be fiercer for girls as they will want to attend the attached high school. Overall, the school is around 2/3rd female.

younger teacher, SB1, noted a dramatic change in girls' grades moving into the second year of High School, but did not point to the *bunkei/rikei* split. Instead, he concentrated on the content difficulty jump.

> From the first year of middle school to about the first year of high school, girls will definitely have the better maths grades. Like, for the school tests if you ask the questions 'have you studied the textbook?' or 'can you properly use the equations and formulas I taught you in class?' then, like I said before, the kids that do not just one but two, three loads of the homework will of course have good grades. If the boys are skipping [class] then they can't make those grades. So, girls have high scores, but when they become second and third year high schoolers the contents, the difficulty, of the maths noticeably jumps. If you ask them to apply what was learnt in class, move on to those hard problems, then girls, surprisingly, from that point on aren't able to get the grades. They're able to do what we'd done up till now *really* well, but from that point on if you make it a bit more difficult, girls really…girls are said to be bad at thinking flexibly. In contrast, boys, even if ordinarily they look like they're not really properly participating in lessons…it seems like boys are strong at quickly switching their ways of thinking. - SB1

6.3.2.1.2 Developmental Change

Another common way to frame the 'change over time' pattern is that it is a matter of development – both physical and mental. Teachers referred to the idea that boys develop more slowly than girls, meaning that for the early stages of middle school boys are automatically 'behind'. During the second or third year of middle school boys have caught up developmentally with girls and therefore their grades will now either match or exceed them.

This is reflected in how we have seen teachers describe their pupils: girls are grown up and well behaved, boys are childish and slapdash. Girls are quiet, complete the tasks they are given, are polite during lessons etc. By contrast, boys get less glowing reviews and have their own set of 'buzzwords' to match girls': teachers commonly use words like sloppy (*zatsu)* and noisy (*urusai)* to describe them. In the eyes of many teachers, this was partly down to personality differences between the sexes, and partly due to boys' relative physical immaturity. Girls' relatively faster development explained why they had an early lead on boys.

> But…as a whole there's a lot of boys who really haven't developed the habit of studying, so in that way there's more boys who are bad at maths. Of course,

> girls develop at an earlier stage compared to boys, grow up quicker, and their mental age is higher so…their desire to study is also higher…that compensates for any areas that might be a bit…so if you compare them of the same age then of course girls are better at maths. – Z14.6

As boys developed throughout middle school they would eventually be on par with girls physically and mentally by the time they were in their final year. This was a common explanation for the pattern advanced by many teachers, including B1.1 who generally did not feel there were gender differences in achievement.

> At the level that girls enter [middle] school they're comparatively more adult in their train of thought, their sexual characteristics…but, particularly boys at this school, at that point they're really childish. They look like elementary school kids. So, it's basically like older sister and little brother – that's what it looks like. When they get to be in third year boys have finally developed, they look about the same age. Their height is the same, their personalities too. [Interviewer: how about grades?] By third year they've overtaken, I think. I do think that. – M2.2

> Maths does get much harder at high school level. Looking at middle school entrance exams [7]- girls get better grades. That's to do with mental and physical development, and girls are faster to develop. I think by the time they're in maybe second year middle school the boys have caught up and may be overtaking in mental development. At first girls are on a higher level - then between the ages of 13-15 boys will quickly develop. And due to that development boys get a boost in maths skills and the gap starts to open up. - TO.1

> *Individual* ability, I think, rather than a sex difference. However, middle schoolers are, in Japan, grades seven to nine, right? I think just in those years they develop hugely. When we switch over from more concrete/literal operations in maths to being able to do abstract thinking – that's generally from first/second year of middle school, I think. Generally, between boys and girls, girls develop earlier. Therefore, when you want to move into abstract maths in middle school second year girls are quicker to understand. But, when they become third years, boys have caught up and there's not really a gap I don't think... -B1.1

[7] This is a private school, public schools do not have entrance exams for middle school entry.

This is related to teachers' earlier observations that the type of mathematics and the level of difficulty can shift at a certain point in the system and this can cause girls' grades to drop. A couple of teachers noted that girls could find themselves suddenly struggling when they had not been before. SH.2 said that he thought "boys don't really feel the jump so much, girls seem to be more taken aback by [it]". This feeds back into aspects we have covered such as teachers' suggestions that girls' struggle more with applied, abstract, or other complex types of mathematics.

> That's…if it's the sort of textbook problems, um, they can solve the problems on the sheets I give them but, from then on…by changing the kind of questions then girls' grades drop. Boys' don't drop that much, and there are those who's grades go up too. Obviously, I'm repeating myself here, it's not that all girls are like this, but for me I see girls and boys average scores, and really, to a surprising extent, it dramatically reverses. - SB1

Before we move on, we should note that, aside from the achievement 'change over time' pattern, teachers also saw attitude differences changing over the same period. This is in line with what Isa and Chinen (2014) found. The difference is that, while the achievement differences were sometimes only revealed when making direct comparisons between years, teachers more readily spoke about the attitudinal differences even before they were asked to do so. Many teachers reported that girls' confidence levels seemed to drop as they progressed through the years, and/or described confidence-related behavioural changes. These included traits like girls becoming quieter, more reluctant to volunteer or put their hands up (even for questions), and increasingly caveating their answers opinions before saying them if they did.

> I feel like maybe boys call out a little more. Girls steadily get shyer and don't put their hands up. If you call on them then they answer you but…there becomes fewer and fewer girls who will voluntarily put their hands up even if they know the answer. Well…they don't tend to put their hands up to answer questions, but they do to ask them when they don't understand something 'I don't get it' [Interviewer: and boys?] There are boys like that but there are also boys who will just be like "I don't get it' out loud, when they want. – Z14.4

> …when the girls are writing their own thoughts they don't seem to be confident, and the frequency of them saying things like 'this is probably wrong, but' or 'this is a bit vague, but' increases. In middle school that's not such a problem, they still call out a lot. So, the difficulty of the material and them growing up… being self-conscious…it's much stricter. - BH.Y

As with achievement differences, some teachers also put this down to physical development, and some felt that this overall trend was observable in boys as well – even if it was stronger in girls. Others pegged it as due to the increasing difficulty (or changing type) of the mathematics, including the idea that girls increasingly find mathematics boring, while boys are the ones who start to 'bite'. Others did not offer a view as to why this occurred.

Teachers reported that traits characteristic of girls we examined in 6.2.1, such as lower confidence or a lesser interest, intensified throughout the middle and high school years with girls getting less assertive, less confident, and more anxious about (and/or bored by) mathematics. We have seen teachers say that confidence (and related behaviours) impacts achievement. These types of explanations are our first taste of the idea that teachers see innate (or at least inevitable) differences between boys and girls which affect grade disparities. To a greater or lesser extent, teachers' theories in this section have an underlying assumption that boys are just *better* at mathematics. In the first theory, once boys rouse themselves and start to work in earnest due to the looming entrance exams, it is understandable that they will overtake the girls who have been working steadily the whole way through.

> Um, boys…um…when they become high schoolers girls are obviously steadily working about the same as always, but boys are like 'woah!' - TO2.2

> Girls are really steadily studying…and that doesn't really change much – the amount that they study. Boys don't work. Then they do, suddenly… - X4.2

> Yes, for the entrance exams. Even though girls are working their hardest, in the end it's the boys who are rewarded. That's just maths though, for example with English then that diligence pays off for girls. – TO.1

In the second type of explanation, once boys reach their full (physical and mental) potential, on a par with girls, their best is likely to be better. Although some teachers, such as X4.1 and TO2.1, said that boys are just 'better' at mathematics, neither of these things were made explicit by the teachers here – and it may not have been what they intended to imply.

6.3.2.2 Different Values and Lenses Obscure Gender

We will explore the reasons for this being the case in Chapter 8 in more detail, but there is also a resistance amongst many teachers to look at things using the lens of gender. This can be the difference between seeing differences between boys and girls and recognising them as being gender differences.

A resistance to labelling something gendered *as* gendered is particularly noticeable in those teachers who said gender differences were 'personality' differences rather than gender itself. This can produce an interesting effect, such as SH.2, who sees gender differences but also said that he did not see them as gender differences.

> In my personal opinion it's not a 'gender gap', it's a personality gap. I think it's a gap that's come of personality differences. So…boys have a boy-ish personality, boy-ish? How do I put it…For girls there's a tendency to have a certain personality, for boys there's a tendency to have a certain personality. And that personality that you have…whether you're good at maths or not flows from that.
>
> [Int: So if you're born a woman you tend to end up with a feminine/woman personality?]
>
> Yes. - SH.2

This seemed to come from a place of genderblind ideals and also of individualisation. It was common for a teacher to state something like Z14.1 who said "I don't particularly feel like it's a boy/girl thing. It's a personality thing", or saying that they saw children as individuals (rather than as a member of their gender) was quite common during interviews. This was especially true at, or near, the beginning of the interview and it was still their initial impressions. Teachers like LND

went on to describe differences in achievement and attitudes, but in the first few minutes of this interview he said:

> It's not ' because they're a girl' ' because they're a boy ', more than that it's the class atmosphere, more than because it's maths, whatever subject it is in this class, um, whether there's a sense of security to raise your hand and it's ok to get it wrong, is more important….myself, because it's maths girls are more, or boys are more…that's not something I personally particularly feel - LND

Others expressed the importance of treating children the same regardless of their gender and that teaching should be genderblind. This kind of teaching culture is not surprising in a post *yutori* reform world, which stressed the idea of providing an education to individual strengths (Fujita 2010; Kariya 2018).

> For us, in the end, even though there's a gender gap - like I was just saying, I don't really think 'boys' 'girls' when I'm teaching, so in that way you don't pay attention to it. Therefore, in that way, it's regardless of boys/girls its '[***in English****] even'*, as you'd say, 'even', the same situation, if you can raise them both up then that's a good idea. And then, making choices for the future, well that's up to the child - B2.1

> When you're teaching, particularly 'because they're a girl' 'because they're a boy', you don't really differentiate like that… - T.2

> I've never separated by gender. We're not really conscious of gender. Oppositely, 'I'm a boy so.. I'm a girl so... ' changing behaviour because of that..., not really about that. Because, suppose we become conscious of gender differences, I think it's possible that we can transmit this to the children and they become conscious about gender differences. Conversely. - B1.1

> Well, the difference between genders in the classroom, and the gender difference in maths are totally different things. The gender difference in maths, if you know it, then…if you know that there's a difference then…understand the differences clearly between boys and girls, and then, specifically, with your teaching methods 'this is effective' - if you understand that, then it's important. But, fundamentally, in the classroom…more than thinking about it as a gender difference, in what way should you teach each student individually - I think that's important at the moment. - B1.3

This feeling that you do not, or should not, consider the gendered aspect too much; instead your ideal to aspire to is genderblind (and/or individualised) was particularly strong in one elite school (B)– it seems to be a part of the general ethos.

So, we have seen that there is a strong preference amongst quite a few teachers to treat children as individuals. Equally, there does seem to be some lingering remnants of the older teaching norm that you should treat children the same. In the literature review, we saw one norm was to consider the whole class' progress and needs holistically, rather than turn to ability streaming etc. This latter philosophy belongs to a time when there was a strong aversion to discussing demographic differences like class for fear of reifying them. We will return to both of these ideas in Chapter 8.

> I've never thought about raising only female students' maths interest/ability, both boys and girls, I'm thinking about raising the maths interest of the students who are in my classroom - so I haven't really thought about female students in isolation. - B1.2

Whatever the reasons, the result is the same: either you use a truly individualised approach, and it becomes easy to miss the gendered aspect, or you consider your class as a whole and the same thing happens. Neither value in teaching culture leaves much room for gender; the approaches are either too 'zoomed in' or too 'zoomed out' to see gender differences.

Now we move to a third potential factor behind why gender gaps are largely unrecognised and unproblematised. Even if a teacher pushes aside any pressures of credentialism on their pupils (and themselves), and not only notices the differences between boys and girls but also sees them as gender differences: how easy is it to problematise something like this? Girls are not falling short of the criteria of an ideal mathematics student because they are seen as lazy or stupid – indeed they are described as diligent and careful with their work.

6.3.3 Inevitable? Innate?

A third factor seems to complicate how teachers 'see' the achievement and behavioural/attitudinal disparities. We have seen how problematisation can be blocked by teachers not noticing the gaps (or not seeing them as gendered) because of certain conditions. Here we see (almost) the reverse: teachers recognising a gender gap as gendered, but not problematising them. Here, whether teachers perceive the causes of the gaps as possible to change, or not, affects whether they problematise the gender disparities that they do notice.

To do this we will draw on teachers' answers to a range of interview questions including; explanations for why there are so few female mathematics teachers, their thoughts on the impact of household environment on pupils, how teachers make sense of the large PISA achievement gap etc. Reasons that teachers gave for the PISA achievement gender disparity are familiar : girls dislike or are uninterested in mathematics, girls struggle with applied mathematics and other non-curriculum skills which become core in later school years, girls give up quicker, boys are simply better at mathematics and girls are better at other things, girls have a different style or lack the intuition etc. However, what we concentrate on here are the root causes teachers described for the disparity, which underlie many of the aforementioned reasons they gave for the gap. In fact, one of these root causes - socialisation, and its reasons, was the most common reason teachers cited for the gender disparities.

We have already established what teachers feel is necessary to be good at mathematics, and what teachers thought were major factors behind the PISA gap. These are also the characteristics that they do not see in girls: confidence, application ability, and liking mathematics. They also put forward other causal factors, including ones that feed directly into those 'big three'. What did teachers think was ultimately behind those factors? We explored the mechanisms behind the development of application ability, and why teachers feel that girls struggle to do so. Confidence and interest (as in enjoyment and curiosity) in mathematics play a part in it, but where does the lack of confidence and lack of interest come from? The two major categories of root causes can

be grouped into innate, and non-innate ones – although the line between them can sometimes blur.

6.3.3.1 Inevitable? Non-Innate or Pseudo/Semi Innate Causes

The majority of teachers felt that the root causes were socialised. Childhood socialisation was thought to play the biggest role, with childhood play being the most critical. Girls playing with dolls and reading books - rather than running outside, playing video games, and or using blocks (like lego)- was considered to be the source of boys' superior spatial awareness and mathematical thinking.

> If you go back even further to the start, then girls are playing house and things like that right? That kind of role division…boys are freely playing outside……getting that kind of way of thinking. Thinking about things on your own…I'm thinking that boys are blessed with comparatively more opportunities from when they're little…as a subject it's stressed pretty strongly that maths requires you to be thinking independently for yourself so…at that preschool education stage there's an influence on the fact that there's more boys who like maths, less girls who like maths. I think yeah, influence from when they're very small. - NA1

> Why I wonder? Plastic models, games etc they develop their sense of shape/space, so I think boys are obviously more acclimatised to that – that's how I feel. - B2.3

TO.1 explained that, since women were able to enter top universities, that it must be possible to improve girls' mathematics (the implication being that it was not something innate causing it).

> …in the end, it's due to the home environment in infancy. Set their level skillfully from when they're young, get them to surpass the hurdle with their own power/ability. If you can do that, then I think it will get better. - TO.1)

He also explained his thoughts on the mechanisms of how childhood play changes girls' mathematics skills; like several other teachers, he felt that the process changed the brain.

> I wonder if that aspect is set, to a degree, from birth. Like, if you look at abroad that's true there too - girls like dolls, and boys like cars and boats and things, like those 'cool' things...from that point their 3D space awareness is different. Boys play with blocks from when they're small, and they gather things up together and make things. So, they have to hold an image in their heads and then make it, that spatial awareness, and then that influences their skill in geometry. That's developing their spatial awareness, their grasp of space in 3D. But girls who are playing house, they're doing emotional exchange - looking at their parents'

> home-life and they mimic it…Even if they're a girl, if they like playing with blocks I think there's a high chance of girls improving their mathematics ability. - TO.1

For most teachers this was down to factors such as the toys that parents gave them (and/or that society encouraged them towards), but some teachers were unsure whether the preference for one type of toy or play may be innate. In this case, although the play itself is what makes the impact on mathematical ability, the preference pushing them towards one may be innate.

Parental influence was also highlighted when it came to introducing children to mathematics and numbers early – almost all the female teachers were from very STEM-oriented households, including several whose mothers had been mathematics teachers themselves. Some of them (along with a few of the male interviewees) commented that counting and arithmetic had been a part of early childhood experiences for them.

> My parents liked puzzles…and my mum worked in a bank. So money calculations and things…we did a lot of things like that. From when I was very small it was about pocket money and things like that. It's like I got…used to numbers? So kids who aren't in that kind of environment at all are probably different. Whether you pick it or not, you're given different choices. – X4.1

> Yeah. Our household was an electrician's, we were in the business, so when I was small we used to close the shop about 8pm and I'd be counting the money, checking on the days takings etc, checking those numbers. So, in that way I got used to numbers. That kind of environment has an influence, I think. - T.2

Broader societal differences between men and women were also believed to be causal. These include aspects like the lack of female role models in STEM (particularly mathematics, physics, and engineering), with a couple of teachers even remarking specifically on the dearth of female Nobel prize winners. Other differences, which we return to in Chapter 7, included the societal image of mathematics being masculine and 'for boys', and the visible imbalance of men and women in the STEM workplace more generally. This is an area where the Themes of interest (2) and choice (4) also play a part.

> It's probably, purely, that girls'…interest in maths and science…is generally low, compared to boys. So, there's a possibility that the time they spend studying will end up being slightly lower. And if that's the case, there's a possibility that that will be expressed in a score gap. I think. And for me, the computer/technology areas where maths and science are important, have for a long time been like a 'boys club' so women have sort of kept their distance. Life sciences…and medicine? That sort of thing is fairly female, there's lots of women. Like engineering, technology related…in Japan there really aren't many women so there really aren't those who aim for them…middle/high school students can't imagine those things. They as women are…they can't imagine themselves working in those spaces so perhaps, as a result, what happens is in this way their interest in maths might weaken. - B2.1

> Discussing all this the thing that springs to mind is 'society'….Society's atmosphere, its trend… there's this current that 'boys are *rikei*, girls are *bunkei*'…don't you think? Like 'Wow, girls who can do maths!' makes it feel like a rare thing. - X4.2

These causes occur so early - childhood play, household environment, the impact caused by an overarching social climate – that, practically, they can be called 'inevitable' or pseudo-innate (but not completely innate) causes.

6.3.3.2 Innate Causes

Teachers also reached for innate, or inborn, differences between boys and girls as explanations. Most of these were references to brain differences, and the resulting skill or orientation difference between men and women.

> With boys and girls there's particular qualities…the brain…the structure of the brain or…I wonder whether there is one…the ways we grasp information or thinking power…I wonder if there's a…gender difference…I wonder if it's that. I really don't know if there is one. - T.2

> So, um, in Japan there are women who can't read maps, there are guys who can't either [laughs]. Women are...there's a lot of women who are more wordy...they're strong in language related things - they're left brained - conscious of that brain structure…and there's more men who, rather than language, it's about grasping shapes and numbers - I think they're better at that kind of thing. So, while thinking that it's kind of natural / expected that there will be more men, however I was also at [*prestigious women's]* University and I

> was surrounded by female students, so of course there were lots of girls around me who were good at maths. - M1.2

A few teachers theorised that these brain differences were due to remnants of our hunter-gatherer past.

> Like I said earlier…there's a lot of girls who are bad at 3D shapes, I said that but…that's something that can't really be helped. What I've heard is that in ancient times, before civilization, men went out while women stayed home and looked after the home. And from then on…women…not because of contempt or discrimination or anything, didn't have a lot of experience going out of the home and then coming back…so men were equipped from long ago with a sense of direction and spatial awareness. Women were in the home, a single place, looking after the territory – that's a custom of old so that ability was divided between men and women. So that stuff that we're carrying from birth…it [gap] might be coming from that. – Z14.6

There were also teachers who were unsure whether brain differences were making a difference, and if they were, whether they would be an innate kind or more of the variety caused by the play differences.

> I don't really know much about the brain differences. Often men have intuition or with geometry and shape/space - men are better at those, while girls are better at solving calculations and things - you hear that kind of thing. Really though, I do think that. But I don't know whether that's because of the way they're taught or whether that's been created in their brain since long before. - B1.3

Most teachers believed either that the achievement gap was down to non-innate (but potentially inevitable) reasons, or had a mix of both innate and non-innate causes. However, in one striking example, there was a female teacher who stressed that the gaps were *only* down to innate characteristics rather than socialised ones.

> A brain thing maybe? A difference in thinking……men are more, um…theoretical/logical? How do I say it…it's hard to express it……but women think about more things – like with language, you think about lots of things, there's lots of ways of thinking…men are surprisingly pure(/simple), right? Maths too has surprisingly pure(/simple) areas – with one answer. So, that kind

> of thinking…their [men's] kind of thinking is really much closer…er…to maths, I wonder...This is hard! [laughs] I get told pretty often that my way of thinking is like a man's. So, that kind of thing is… ways of thinking is male/female brains…the way of thinking is different I think. That difference is men are, um, more mathematical, they think carefully about the truth/reality. Men are more like 'going after the answer'…simply. Men are like that I think.
>
> [Interviewer: is that society? Culture?]
>
> That's not it. Like, this is my opinion, but it's not home influence it's men and women are different from the moment they're born. That's my thinking, 'my opinion'. – TO2.1

The root causes, socialised or innate, discussed so far affect the other causes that teachers hypothesise are behind the gender gap. For example, teachers say mathematical thinking and interest is built early through things like household values and childhood play, but that few girls do (or are encouraged) to play with toys which develop their mathematical skills and spark interest. In another, teachers explain that brain differences and other lingering biological effects underlie girls' poorer ability to think mathematically and why boys will have a natural flair. It may also affect interest automatically through inborn preferences. Meanwhile, 'society' and societal roles (teachers did not seem to have a consensus on whether these themselves were innate or fully socialised), including the lack of role models or positions available for women in STEM etc.' impact girls' motivation and confidence, which in turn impact their ability to develop mathematical ability through grit and not giving up.

6.3.3.3 Summary

When asked the overall causes for the gender gap in achievement, the root causes such as those described above (socialised or innate) were some of the most popular responses – these too are described as underlying the other causes. That so many teachers put these innate or non-innate (but hard to access) causes so high in their list of explanations for the gender gaps needs to be investigated further. In the next section we will look at how this may affect their ability to problematise the gaps.

Regardless of where (or if you can) draw the line between fully innate or just seemingly inevitable, both present a clear barrier to problematising the gender gaps. Many aspects of these

root causes to gender differences feel very far out of teachers' jurisdiction and ability to affect. Therefore, it would be very understandable for a teacher, even if they did recognise the gender gaps for what they were consciously, not problematise them.

How inevitable do teachers consider these gender differences in behaviour and attitudes? After all, in section 6.2 we saw teachers discuss how things like mathematical thinking was built through actions and attitudes. In the next section we will answer this question by examining teachers' perspectives on fixing the gender gap.

6.4 Fixing the Gender Gap – What does it tell us about teachers' perceptions?

Teachers point to a wide array of possible root causes for gender gaps in mathematics ability and behaviour – some of these are innate causes such as inborn brain differences, but even more were caused by wider socialisation. This is reflected in the equally mixed views teachers hold about whether it is possible to correct the gender gaps, and, if it were possible, who would have the responsibility for doing so. This section covers teachers' answers to these questions, and the implications for understanding how the gender gaps have thus far gone unproblematised. Before we can answer any of these, however, we must first address whether teachers think that the achievement gap should be fixed.

6.4.1 Should the Gap be Fixed?

If teachers are, as a group, reasonably comfortable with the existence of the gender gaps in mathematics then that easily explains the lack of problematisation. In reality, teachers held various opinions on whether disparities and differences should be fixed or not. Although there could be some social desirability bias, it was a common opinion amongst teachers that the gender gaps should be addressed. A few teachers stated outright that they would like to see the achievement gaps in mathematics resolved.

> I'd like to solve it. Well, I think in other subjects there's not much of a difference, I think. - SK3

> I do think it can be fixed! I think we must fix it. – BH.Y

> We must find a solution for this problem. Yes, we must find a solution for this problem… - WS1

This sentiment was more visible when discussing whether it was actually possible or not to fix the gaps, as we shall see in the next section. Or when discussing a more general idea of girls improving in, or choosing to continue with, mathematics. M2.2, interviewed for the second time, explained her disappointment upon hearing that the gender gap in PISA was still so large, even if she had not realistically expected it to be different.

> I did have feelings of [***sadly***] '*Why*?' but I didn't honestly think anything would have changed. That nothing would have changed in those years… - M2.2

> For me, I don't do any teaching methods where I'm separating boys and girls, I want them both to do as well as each other and I do lessons with that in mind. And if a gap opens up between boys and girls…in that way I feel like it's something that can't be helped, that's what I end up thinking, but I do find myself wanting to support/encourage girls more that's how I feel and I'm like 'I want to do something for them!' - SJP

> More and more, I'd like lots of girls to choose a maths path. Even if they do so to the university level, there aren't a lot that continue beyond that. - M1.1

> Well, if we don't do something about the gender gap…I don't have any suggestions/thoughts on that. But, of course, when kids become like "I've done it!" they seem so happy, and doing the work of a 'teacher', I feel like I want to help them learn. The happiness they feel when they can understand is amazing, to see them develop their abilities, to witness that from many angles…I strongly feel like I want to help the children to understand. As a teacher I want to help kids understand - you can feel their happiness when they're like 'I get it'. I really feel like I want to help kids to understand. - LND

However, there was a large group who made more tempered statements. This is not particularly surprising considering so many teachers felt that innate or inevitable (i.e. pretty uncontrollable) factors impacted the gender gaps. For some teachers in this group, if a PISA test size gap should appear in their own classrooms then, yes, a solution must be found. There was little sense of urgency to tackle any gaps that might be there at the moment, as if there were, they were small and not worth worrying about.

> At our school, there isn't such a clear result [gender gap], so, if there was such a thing, then it would become a topic and we'd think of measures to address that but…but we don't have that here. -Z14.1

> Well, if the gap opens up, then I think it would probably be best to think of some measures - B1.1

Other teachers acknowledged that there were achievement disparities, but did not feel strongly either way about a need to find a solution; It might be nice if the disparities were solved, but it would be fine if that never happened. Some of these teachers felt that the gaps *should* be fixed but that they did not *have* to be fixed. They, personally, would like to see the gap improved, but that there was no obligation to do so.

> I wonder…I don't think that it's something that we *have* to fix. But, as a middle school maths teacher, of course I'd want boys and girls to both be able to do mathematics, and increase their ability to solve problems etc. I think that it is definitely better to do that. The 'why' and the causes of how this has come about, if there is a way of getting around this 'sense that they can't do it' thing…then I definitely think we should do it. - NA1

However, there was also a group who both recognised (often large) gender gaps in achievement but did not feel that it was a problem and that there was no need to 'fix' it. The most common form of this sentiment was that it was fine if gaps exist in mathematics because it was an expression of 'balance' between men and women.

> Nope. I think it's good. Mutually…um…mutually different so there's balance. The things men can't do, a, that men can't do women can do. The things that women can't do, men can do. That's reflected in mathematics. It's a different issue. - TO2.1

> Well, in my...I don't say this to my female students, but...I think good for there to be differences between boys and girls regarding mathematics. Yeah, so conversely if you said to me 'it's best to have the gap become zero' then I'd have to disagree. 'Now, it's best to have equality between men and women' there's lots of talk like that. But in this case, I think it's best to have a difference. Obviously, I want them to be able to do mathematics, but I don't think I'd want to erase their thinking styles and study methods. Girls are girls and I think their way of doing things is one of their strengths, their advantages…that's what I think. – SB1

> I mean if you want to *eliminate* the gender gap then that…might be important I think but women have an important role…they can do things that men can't. So that's men/women's…there's two…there's parts where you can get balance. So, I think forcing the elimination of that gap isn't really important. – Z14.6

This is strongly connected to a central theme of Chapter 7: that mathematics is pegged as a masculine subject and contrasted with other 'feminine' disciplines.

It is safe to say that teachers had mixed feelings on the desirability, or urgency, of finding solutions to the gaps in mathematics. Some teachers were emphatic that it should be fixed, others did not say so outright but it carried through in their tone and discussion; others were unconvinced that it was a serious enough problem to warrant intervention, and other were comfortable with the gaps because they represented balance between the sexes.

However, there was clearly room for teachers to change their mind - with some even commenting that their interest in the topic had now been sparked and they wanted to investigate it more. One teacher, SB1, expressed a mixed set of opinions during his interview but also speculated that it might be possible to do a widespread survey about how different teachers approach pupils' education based on gender and that this could be used to start discussion of the gender gaps themselves.

> It also lets you bring this sort of thing [the gender gap] up for discussion, I'm very interested. I think other teachers would be very interested… - SB1

> Before this interview I hadn't thought about any of this, but now I'm really interested! – BN3

> I've there's really a…proof…a cause then…if there was a medical reason…then I have no idea what to do. Honestly I've not really thought about gender seriously before so…what I think when we're talking…I'm curious now. Really. - SJP

Getting a comprehensive perspective on teachers' opinions for this question is made harder as not all teachers answered this question directly. For many interviewees, any consideration of the 'should' was blocked by the 'could', and their answers reflected this: could the gender gaps be fixed? In the next section of this chapter, we will tackle what teachers felt about this central question.

6.4.2 Possible to Fix?

The notion of the gender gap being 'fixable' meant different things to different teachers, so we will first look at these various definitions. A few teachers were emphatic that it would be possible to resolve the academic disparity.

> I do think it can be fixed! I think we must fix it. It's not something I can do on my own, it's a whole-society thing, women have to generally participate in society that's important too. I think we can improve it. - BH.Y

However, this level of confidence was much rarer than a more cautiously optimistic view.

> I'd like to solve it. Well, I think in other subjects there's not much of a difference, I think. I think I'd like to try change the perceptions. uh…but…but. Solving it completely...totally turning it around will take time, but improving it is doable I think. - SK3

Of those who felt it would be possible to address the academic disparity between boys and girls, there were far more teachers who felt it could be 'filled in' and there could be improvement

– even though it might not be possible to eliminate the gap entirely. KHW pointed out that other countries have smaller disparities, so it must be possible to find at least a partial solution.

> I don't think we can eliminate the gender gap, I think we can fill it in. But reducing it to zero? No, I don't think so. Changing the fundamentals…the girls and boys who are alive now then I don't think that's possible. [Interview: so next generations?] Yeah, like with each generation can, bit by bit, change it. - B1.3

> I think we can get it a bit smaller, but…for example…yeah. Well with the efforts encouraging girls into stem, it has increased compared to the past, so if those people have children and raise their kids then it might change a little again…I feel like it might change a bit. - M2.2

Some teachers (and several researchers) pointed out that, even if it were possible to reduce or eliminate the gender gap, it would be difficult to do.

> Fixing the gender gap is…very hard.. it's a bit…I can't think of anything at all that could be done to fix it…[laughs] I think it's very difficult. But there's also a lack of research on it…and I've never thought about it…so I can't imagine…it's hard…parents and children…government. I guess that's why you're studying this. - BN3

> With mathematics, if we put effort into it, we can fill in that gap….I think. But…I wonder…closing the grades gap…but I feel like the fact that boys do better on those tests won't change – Z14.6

Others were not convinced that even reducing the gap would be possible. For a group of interviewees, they were not just unsure whether the gap could be reduced, but unsure they had any idea whether the disparity could be fixed at all. Interestingly, Z14.4, who was one of the very few teachers not to report any gender differences in her own classroom, was one of those who was very unsure that anything could be done about the mathematics gender gap – stating the fact that there were also gender gaps in other subjects.

> Honestly…I'm not sure if this is a solvable problem. In terms of numbers it's 'men' and 'women' but…causes…there's probably factors that I haven't studied so I don't know but because I don't really know the causes it's not really something I can judge I think. I don't really know, I'm sorry. - B2.2

> I have no idea! [laughs] I really don't know, but I'd be interested in that research. Not just maths either……I…have no idea…with that…in that sense…that difference, the gender difference/gap clearly, if it becomes clear then there's it's important that I think about it but…until that point. - TO2.2

As with those who were emphatic that something *could* be done, it was rarer for a teacher to be emphatic that it was not possible at all. TO2.1, who stressed that gender gaps were caused by innate biological differences between boys and girls rather than socialisation was, unsurprisingly, unconvinced that anything could be done. However, most teachers who were dubious about whether you could fix the gap were softer in how they expressed it.

> Hmm, well you see girls are…girls, of course, don't really like thinking about maths really. So, if they can do maths reasonably well then after that they go into a world that doesn't really have anything to do with maths. - T.1

> Well, if the cause of it is because boys have more interest in maths then…then there's not much we can do in terms of teaching…that's difficult. – Z14.1

Interestingly, some teachers who said that the achievement disparity could not be fixed still went on to give suggestions on how it could be done – including M2.1 who changed his mind in his next sentence. Teachers in this sample were not united either on whether the gap should be fixed, or even that it could be fixed. Few teachers were certain that the gap could be resolved completely, or that it definitely could not be. Instead, most of the interviewees either felt something that could be done (if only a little), or said they had no idea.

In Sections 6.4.2.1 and 6.4.2.2 we will see what suggestions teachers had for fixing the gender gaps (in achievement and the attitudes that feed into them). The first section tackles how teachers responded to being asked about ways to fix achievement disparities such as the PISA gap. The second provides a comparator to the first by looking at how teachers responded to being asked about ways to fix specific issues they had identified as feeding into achievement disparities: confidence and interest. As we will see over the coming sections, a number of teachers make suggestions for addressing the gender gap – even if they did not say it would be possible to do so

when asked directly. A number of teachers also withheld judgement at this stage, which could suggest that if there were more information available then there would be a receptiveness to discussing solutions if the opportunity were presented.

6.4.2.1 Potential Solutions

Unsurprisingly, considering the prominence of socialised root causes in teachers' explanations, most of the solutions centred around 'society'. Some teachers were non-specific, only referencing the idea that 'society' had to change for there to be progress on the gaps. Others suggested specific measures such as role models, encouraging girls to play less with stereotypically feminine toys (e.g. play with blocks, rather than dolls) to develop interest and mathematical ability, or to fix broader societal level inequalities between men and women – such as in the workplace (we will return to this in Chapter 7).

> Yeah, like "I want to be like that". I think it's good if there are role models. There aren't really any for women, like Einstein and Pascal etc everyone is male and there aren't any women. If there are role models then they're in the humanities like in literature etc. And, historically, even then it's been mostly men, for women there's been *Genji monogatari* - things that women invented like hiragana. So that was women's culture, men used kanji… - TO.1

> For filling in [the gap]? The absolute first thing would be play, wouldn't it? Like 'look at what your friends are doing' 'go outside' playing with blocks…etc. Like robots…then let's build a robot, let's make a rocket. Not about whether it's girls or boys, it's about making kids interested into these things. 'Making the environment', I think so. That would be the first the step. I'm not a parent so I don't know [laughs] – B1.3

> I think [it being the responsibility of] the 'government' or 'ministry of education' is wrong. Girls and boys have to be educated the same, so it's not like boys are given more strength. So…if you take no notice of it then of course then, Japan's up till now,…how do you put it…interest? At the moment, women's involvement…there's a bit…up until now there hasn't been much of that. Up until recently women have been housewives in the home, looking after the home…it's that kind of thing. Women have made progress in society steadily, but it's not perfect yet. – T.1

Teachers also saw things that could be done at school to improve the situation. Some said that teachers needed to be aware of the gender gaps to be able to help, others wondered if there might be some utility in single sex education, and some focused on things that teachers themselves could do. One teacher, B1.3, commented that even if it is something innate (his example being brain differences) then it was not his role as a teacher to worry about that, but instead to focus on what they can do to improve the gender gap regardless.

> I don't think we should worry about the differences. We're not brain researchers, we're not involved with and we don't know anything but teaching so… [*and later]* Like I said before, brain differences…if there are brain differences then we won't be able to change it…but I think it's possible to think of ways to fill in that gap – B1.3

> After that, there's also…teachers…making sure that teachers actually know about it, and the importance of making little changes to your approach…but I don't think that teachers in other schools are particularly aware of this…that's my feeling. - M1.3

> If it's eliminating the gap, then dividing it up into 'boys education' and 'girls education', with more high level maths education aimed at girls and with boys…continuing what we've done until now. That education…I don't know if it's equal but…do that and kind of hammer it into girls' heads – Z14.6

A couple of teachers felt that the best thing for teachers to do about the gender gap was to deemphasise the gendered aspect of it.

> Well, what teachers can do is not make judgements based on sex. So…not making judgements…look at results and feel 'ah, there's a gender gap'. I think it's, of course, related to personality…for example I have the impression that there's a lot of boys who have a personality that hates losing…for example they'll be doing a calculation 'I want to solve this quickly' that competition, and 'solving a hard problem…but I want to solve it' that kind of personality is influenced from society. Getting more girls to have this kind of personality will be societal influence. So basically what we can do is, without paying attention to it, as much as we can…for the 'negative' kids too…bring out their competitiveness, make them think thoroughly, not let them give up. -SH.2

When teachers were asked about whether the problem was fixable there was a very mixed response, but when asked for specific suggestions of what could be done towards this goal (which

was done regardless of their response to the former question) many teachers were able to make suggestions. This does indicate that they *can* see a way that something could be done, but perhaps did not consider it feasible or practically possible – this is a critical idea that resurfaces in Chapter 7 too.

It is unsurprising that common responses were focused on societal level changes – after all, 'inevitable' (even if not actually innate) differences were some of the most common causes teachers pegged as causing the gender gaps. However, this seems to affect teachers' ability to problematise the gaps if solutions were seen as out their reach to implement; if their theories such as the importance of childhood play are correct, then by the time children get into their classrooms in middle and high school it would already be too late. However, we also saw here that there were many teachers who also felt that there were things that could be done at the school level. Indeed, if we phrase the question a little differently, and ask it in a different part of the interview, we see that many teachers did think there was a lot that could be done. They thought that there were things that they could do, personally.

6.4.2.2 Raising Confidence and Interest

Gender disparities in confidence, and in mathematics interest, were two of the big culprits behind the PISA gap according to interviewees; weighted alongside lower application ability and the aforementioned socialisation causes which help feed into them. As we saw earlier in this chapter, confidence and interest are also two of the major factors that teachers list for being good at mathematics; and also characteristics that they described girls as tending to lack. Therefore, separately from asking how 'the gender gap' could be solved, during an earlier stage in the interview teachers were also asked how to raise girls' interest and confidence in mathematics. Although there were a couple of teachers who said they had no idea, the majority of teachers had lots of suggestions on how to improve both measures. Interestingly, these mostly focused on things that they themselves – as teachers – would have the responsibility for doing.

6.4.2.2.1 Interest

First, for interest: by far the most popular suggestion was the use of real-world connections. This entailed communicating the links with, and the utility of, the mathematics they were doing in school with daily life and pupils' future careers i.e. broadening the conversation to include mathematics that was not just focused on the content of the textbook and exams.

> Yeah. Of course, regularly, like I said before, whether they get lots of chances to have contact with mathematics. After that, then in their every day life, there's lots of maths-related things that the person themselves don't realise, so I think helping them to realise that would be one thing. 'Actually that's mathematical thinking' or 'you know, that's something related to, connected with mathematics!' - M1.1

> Of course, understanding things is very important, in the end 'I have to clear this exam'. But those doing nothing but lessons with those short term goals then that won't help with making maths interesting. You can create interest by showing how maths will be useful later definitely. So, I think incorporating that into lessons will be the most important thing I think. If It's just always about exams then… - TM

However, there was also concern expressed amongst some teachers that their usual method of trying to use real-world connections only seemed to work for boys. One such example was the problems faced by young teacher, SB1, who felt he knew what worked for his male students but could not get the technique to work for girls. For him, the way to engage his students was to bring out the real-world utility of mathematics and help them to see it in things beyond the classroom – something that had been instrumental in growing his own interest. However, he was demoralised by the fact that the girls did not seem to respond with any enthusiasm and was not sure why. Chapter 7 will explore this perception further from another angle.

> Often, to my current high school students I say "Really, the maths that you guys are studying now can be used in this way". And when I tell them that, in everyday life, there are these kinds of mathematic phenomena etc girls don't really have their interest peaked by this. Like, "This won't come up on the test, right? … But boys are like "oh, wow"…… in the end, it's boys who want to

> deepen it more and more. They bite …… But, with girls when you do this they can be like [**bored voice**] "is there really any point to this?"
>
> [Interviewer: A big difference then]
>
> There is a big difference, yeah. The reason for such a big difference coming out…why that kind of difference occurs, I really don't know, but there is clearly, definitely a big difference. - SB1

No teachers offered up a specific way of tailoring this approach to girls. Researcher SM.R agreed that this approach of 'real world connections' is instrumental for helping to fix gender gaps; she recommended basing questions around STEM careers and scenarios that girls were interested in (such as medicine) rather than those the teachers had mentioned (such as engineering). However, a lot of teachers made no mention of any necessity for tailoring the approach to girls and instead focused on how the technique would raise pupil interest in general.

> I've never thought about raising only female students' maths interest/ability, both boys and girls, I'm thinking about raising the maths interest of the students who are in my classroom - so I haven't really thought about female students in isolation. – B1.2

They spoke of this technique without referring to gender at all, or said it worked for everyone – although both the teachers themselves, and the literature, recognise that girls do have a lower interest level in mathematics.

When they did tackle the idea that the approach would need tailoring head-on, some of the teachers either suggested framing it outside of careers entirely (but without any examples), or that you should somehow get girls to be interested in the same things as boys first.

> Another one is showing the concrete uses in society for maths. Then there's also, while they're middle schoolers, 'this part will be useful for when you're in high school ' and if they're high schoolers then...there's a lot of girls who won't be doing it at university but then you can be like ' when you're out in society then it's useful in this scenario' if you say that they think ' oh, right! ' and they get motivation from that - there's girls like that. There seems to be. I think if teachers can communicate this sense of how what you're doing now links with what you'll be doing later, then that's good. – M1.3

> Well with boys…well engineers etc, people who use mathematics in their careers - talking about that with boys. In Japan, well probably elsewhere in the world too, but in Japan boys find it interesting, like "that's interesting". So, for boys then engineering…with engineers etc 'you use this in real life in this way'. Well, of course, there will be girls who also find this interesting but, but for the majority of girls that's not the case I don't think. They give you a sort of 'huh?'……Amongst girls, there are those who are interested in things like robots or science, if you could increase the number of those girls then you could steadily make maths more interesting for girls. But it's how to create that interest that's difficult. B1.3

So many teachers were united on real-world connection being the best way to promote interest in mathematics – but none of the teachers interviewed had a concrete example of a way to do this for girls specifically (as they are now, without waiting for a big shift in how girls are socialised). We will see in the next chapter that the influence of life-course is extremely strong on teachers' perceptions of these gender differences. Even if they were not sure about specifics for girls, the fact that so many teachers agreed on this technique suggests that if teachers did gather to discuss the gender gaps they could brainstorm ways of making it work for girls too. Especially if they had some helpful input from researchers like SM.R to get them started.

Another major suggestion from teachers for driving up interest was role models. This was one of the few suggestions for this question that was outside of teachers' direct control and has obvious connections to teachers' view that societal change would be necessary.

> Role-models - being able to see *sempai* who you can look up to, adults you can look up to. Schools raise up dreams. [Interviewer: so, more women in mathematics jobs?] Yeah. Definitely. Seeing really excellent examples – like, there's a tennis boom at the moment because of Nishikori, right?...like, if people like that appear then I think things would completely change - KM1

Although not in response to this question, most of the female teachers and researchers described an important role model in their own lives as being a major influence on their decision to go into mathematics. Strikingly, this was generally a family member, almost always the mother, who was a STEM teacher or worker themselves.

> [Interviewer: Your parents were maths teachers?] Yes. My father didn't teach middle/high school - he was a university professor. My mother worked as a high school maths teacher at a private girls' school. My older brother is a mathematician, he was a researcher at [*University Name*] - KM1

The difficulty teachers had in describing ways to engage girls specifically was also apparent in how many teachers who just said that the key to raising interest was simply 'to make lessons fun and interesting'. This was usually not accompanied with a specific example of what an interesting, material, or fun thing might be.

> Sorry, give me a moment…….making it fun I think. It's going back to the making it fun stuff we discussed earlier. When you're solving a difficult question 'this is fun' that kind of thing is something I think is more what boys…so…it's about the idea that solving things is fun, learning new things is fun…the thrill of discovery and…I think if we could get girls to feel that, then more girls would improve. The percentage of girls who are doing that while feeling happiness is fairly low I think. I think if we knew how to do that it would change…up until now, the kids that I've seen that really, really like maths and are really good at it are ones that have fun doing maths…and in terms of ratios there's more boys who are like that. – BN3

> Well, first off, from our side of things, developing lessons that spark student's curiosity – that's definitely important. Then…if you can get them thinking 'even though I couldn't do it that was pretty interesting' then that links to the next thing. So, lesson planning, and its relation to the children is definitely important I think - NA1

Teachers see the necessity of sparking interest, and could see general ways of doing so, but struggled with specifics. When they did describe specifics, sometimes this contradicted what we have already heard about girls and might lead to problems. For example, some teachers suggested that puzzles would be a way to engage pupils and make it 'fun' – but we also know that teachers see girls as being put off by challenge. This stood out as many teachers (including the female teachers) describe things like challenge, competitiveness, and the puzzle solving aspect of mathematics as things that drew them themselves to mathematics.

Teachers were clear that things like real-world connections and teaching fun/engaging parts of mathematics was the key to raising girls' interest, but the missing aspect was how exactly to do that. In answering this question, teachers tended to gloss over the idea that girls might need a

different approach or simply said that they were not sure how to go about it. Perhaps it is a matter of their own perceptions and they struggle to relate; most of the teachers are male, and even the female teachers described themselves very similarly to their male colleagues in their motivations and interests. We return to this idea in Chapter 7, but *rikei* oriented, mathematics loving, mathematics teachers may not be able to put themselves in their *bunkei* oriented female pupils' shoes.

When it comes to the issue of increasing girls' interest in mathematics, teachers have part of the solution, but it seems like they would need an avenue for discussion to be able to share their perceptions of the problem. Knowing that teachers see interest as determined in such a large part by socialised causes, such as childhood play, it seems like this could be a stumbling block for recognition and problematisation as this happens at a much earlier stage in life when teachers have no ability to influence. It is also telling that the techniques for raising interest (aside from building confidence) are intimately connected with careers – we will examine in Chapter 7 how this too would likely affect teachers' perceptions of whether there are feasible solutions to the gender gap.

However, several teachers also stated explicitly that the key to improving girls' interest in the subject lay in improving their confidence. This is what we will examine next.

> So with practice then you'll gradually get used to it, and in turn you'll increase the number of questions you can do. And you'll give yourself confidence. And if you do that you'll start to like it. - TO2.1

> Ahhh…well, I mean. It's like…proportionately I think they both rise together. If you can do it then you get confident. Your self efficacy and your desire to do it will rise I think, they're different things I think but proportionately the same. - B2.3

If teachers struggled with the idea of raising interest in their female pupils, there was no such issue for confidence.

6.4.2.2.2 Confidence

Teachers had a much clearer idea of how to raise girls' confidence. Suggestions even included gender specific ways, tailored to the kinds of personality traits and approaches that we have seen teachers describe in girls. The biggest category of recommendations were 'theory-perfect' explanations for how to raise self-efficacy, as covered during the literature review. For example, factors such as praising girls to encourage healthy self-esteem and resilience, or making sure children have positive 'mastery' experiences of being successful. These are key concepts in self-efficacy literature, and we have also seen how important teachers think these traits are for being good at mathematics (Bandura 1997; Pajares 2006). The quote below from experienced teacher, M1.1, neatly encompasses this.

> Well, one thing is calculation ability, in Japan's case. Raising their calculation ability. That will get rid of mistakes…careless mistakes. If you do that then their confidence will be gradually increased. Also, then you can praise them in class too. Praise them for what they've done like "oh you worked hard" and "you did it' that kind of thing is connected to confidence. After that, there's also making them announce it. Through making them announce and explain it, you say "that's a good opinion" or…that kind of thing and um…that's a good way of elevating it, giving them confidence I think. Like when they've solved a problem, that kind of scenario.
>
> [Interviewer: in front of their classmates?]
>
> Yes! Yes yes yes. Exactly. That kind of thing, um, I want to make and give them lots of, um, success experience. – M1.1

Another common thread was that that girls appreciate step-by-step instruction and encouragement. This also matches up well with the oft-mentioned image of anxious girls with low confidence. This would build both mastery experience and incorporates praise.

> I think it gives you confidence to be like 'I can do this'. The 'I *kind* of get it, I kind of think I can do this' - that doesn't give you confidence. So, with small-steps "I got this" "I understood this" "I managed this" building that up is the best thing. [Interviewer clarifies] But so…boys are more, when they're in elementary school or just joined middle school they're very pure/simple when they do it 'I'm a genius!' they say [laughs] That builds confidence, in a pure way. Girls are more 'It was just one question; I don't know whether I can do it again' I think there's some of that. I wonder if that's where the gender gap comes from. – Z14.4

> They [girls] lack confidence, their sense that they're bad at maths is strong. So, in order to improve that...rather than asking for an answer all of a sudden, instead proceeding by confirming things as you go - 'up to here's fine' 'up to here's good' in steps, confirming that. I think they'll be like 'ah, I see. I get it'. Teaching like that. It's not suddenly concluding things, it's 'up to here's fine, up to here's fine, and here' stepping up *very* gradually...studying like that so you'll reach the right answer and then the confidence issue will reduce. I think. – T.2

We have seen teachers describe girls as shying away from challenges, giving up early, and struggling to put themselves forward to answer questions or volunteer comments. These suggestions were clearly tailored for female students, responding to the question of how to raise confidence in ways that addressed these issues. Popular tactics included praise and encouragement when girls made attempts to participate or try harder questions and encouraging them to keep going when they found something they struggled with.

> Well…I think it's things like evaluating the things that kids do, evaluations not grades…so praising them and attaching worth to them calling out…and then things like 'it's ok if you're wrong' making sure you're reinforcing that in the classroom. So, if you can create that kind of classroom atmosphere then…at least in that lesson then that kind of 'sense that you can't do it' gets weaker so…praising them and that's something that you have to do persistently from the very start. That's connected to confidence, I think. Putting aside whether it's [confidence] is linked with grades, I think that's connected to confidence. -NA1

> Girls are like that. "If you do it for another minute then you can do it, you know!" [girls:] "nope, this is it for me".
>
> [Interviewer: how would you tackle that?]
>
> It might be difficult in other schools, perhaps, but if you can show them clearly the fact that they've managed to step-up / level-up. "You've already come this far! You can definitely manage the next bit", if you can show them that then they'll think for you "ah, I can go this far, and this far, and this..."
>
> Boys are like *'pon*!' they'll like it and think about it and be like 'I did it' or 'I didn't do it', but with girls you have to be like ' today you managed *this* far ' etc you have to do that step by step, encouraging them that they manage it. - M1.3

Although, they said, both sexes would respond to praise, teachers felt it was particularly important for girls who need more reassurance.

> Thinking 'I did it, so let's try the next one' that confidence…I had that. When I couldn't do it "what?! Shit…" is what I thought. But on the other hand, if the hurdle is too high you give up. I think. Praising them…is really important. That's not limited to just girls but…if you can connect it [success] up to confidence then girls will steadily keep going. With boys it's more 'smacked bottom', girls are more 'praise them' …. Something I vividly remember is when I was in elementary school…the teacher gave me a sticker, and with things like when I answered the teacher correctly I'd be given lots of stickers. So…we were all working hard but comparing myself with the other kids I got a lot [of stickers] and that used to boost my confidence. – X4.1

Although there were teachers who said that there was nothing they would do differently for girls, we can see that many teachers did give tailored responses. Teachers matched traits they had identified as common in girls to their proposed techniques in answering this question: Girls gave up or got discouraged more easily (so you should praise them, no scolding. You should encourage them to keep going and not give up). That girls were motivated differently, unlike boys they do not like challenge and jumps in difficultly (so work through things step-by-step, hand holding all the way). Contrast how teachers diagnosed the issues behind girls' lower confidence, and how closely they tailored their solutions to their individual needs, to how they struggled to do the same for interest levels.

Teachers seemed to perceive interest as a more complicated problem to fix than confidence, relating to deeper societal (/inevitable) or innate differences, and they seemed less sure about their ability to control or influence it. We are missing a piece of the puzzle to understand teachers' perceptions here, something that the teachers might not have (consciously) at the forefront of their minds for this question, and therefore do not mention i.e. careers and life course. We will cover this topic in Chapter 7.

Self-efficacy's prominence is interesting too, considering how important it was considered for the Japanese results by the OECD (2013a). Perhaps, as per our discussion on which perspectives/lenses teachers use, teachers have just not made the connection with gender before. However, it does suggest that girls' confidence problems alone would not be a barrier to

teachers' problematisation as so many can see a clear way forward – interest would be the bigger of these two problems.

In this section we have seen that teachers had plenty of suggestions for raising both interest and, particularly, for raising confidence. What is most striking about these answers is that almost all of them involved things that teachers themselves could implement. Amongst those who put forward solutions, there were even teachers who had said that the gender achievement gap itself was not actually fixable and had identified innate or biological causes for the gender differences – TO2.1, for example, had plenty of suggestions even though she was the teacher most emphatic that the gap could not be fixed. Moreover, she said that it could not be fixed because men are simply better than women at mathematics, and that this is the result of an inborn brain difference. Framing the question differently, by focusing on improving a metric that feeds into the gender gap, rather than the gap itself, revealed that she, like many of the teachers, could see ways of improving the achievement gender gap.

6.4.3 Responsibility for Fixing it

Teachers were also asked outright who was responsible for doing something about the gender gaps: who would be able to do the sorts of things they had described, and who (if anyone) would have the responsibility for implementing the fixes.

Understandably, as its influence was considered so critical as a major root cause, the majority opinion from teachers was that 'society' was responsible for fixing the mathematics gender gaps. Either teachers referred simply to 'society' (in general, with no specification) or picked on a particular area they thought was particularly impactful such as reducing the prevalence of social stereotypes about gender, or making sure there were role models.

> From the moment a girl is born it's 'you're a girl, so pink ', ' because you're a boy, it's 'blue ' there's some ' yellow is fine ' or ' girls can like blue ' but somehow…the influence around you and…but for example if a baby is a girl but wearing blue everyone around you would be like ' huh? Why? ' you'd be told that. There's no ill will but…with that kind of thing, and with what toys you give…what other kids, what other girls are doing. 'Why am I the only one playing with blocks when the girls around me are playing with dolls' a kid might look

> around them and go 'that kid is doing it so I want to do it too' and because they're girls playing with dolls they all end up playing with dolls. – X4.1

> It's not the responsibility of students themselves. No doubt about it, it's teachers and society more generally…a country thing. That includes results that aren't enough…I think there are a few differences from birth but…but I think it's mostly a societal problem. - BH.Y

> Discussing all this the thing that springs to mind is 'society'….Society's atmosphere, its trend… there's this current that 'boys are *rikei*, girls are *bunkei*'…don't you think? Like 'Wow, girls who can do maths!' makes it feel like a rare thing. – X4.2

Teachers also specified that parents had a particularly important role to play. This is unsurprising, considering how impactful early childhood experiences (such as playing with mathematics-related toys) were in teachers' eyes for developing both ability and interest in children.

> If I had to narrow it down, I think it's parents' responsibility. I mean, whether it's girls or boys, mum and dad need to be involved…and while they're young expose them to things and get them to think about may things…raising them with all these viewpoints. If a really big gender gap has appeared, then…it might be the responsibility of parents who don't diligently get them to think about things. In that very narrow way, I think it's probably the home's responsibility. - BN3

> It's parents isn't it? [laughs]….if you give the kids lots of different chances, then lots of different interests will come from that. And with maths…there's lots of girls who are interested in maths so…just percentage wise there's not many…but if you can do these things when they're very young then the feelings of 'I want to do lots of things' will come out.--NA1

In fact, elsewhere in the interview, teachers had also been asked about the impact household environment makes on students' relationship to mathematics. Teachers believed that parents imparted values about learning and were best placed to nurture an interest in mathematics itself. Several mentioned their own parents' role in doing just that for them when they were children. Here too, many had highlighted parents' responsibility for encouraging their daughters in

pursuing STEM – a burden that fell mostly to mothers according to teachers and several of the researchers. This was due to perceptions that mothers have a particularly influential role in raising children, and their ability to be a role model themselves to their daughters.

> Yeah, and it's important for both mothers and fathers. But often the mother has the most influence. And it's very important not to crush any interest a child might have – KM1

> This is probably true of other countries too but…mothers have more to do with children than fathers. So, if the mother also doesn't really like maths…both parents will have the expectations of the sons doing maths and for their daughters. They don't say it, but there's this atmosphere of 'it's fine not to be able to do it [maths]' there's that tendency I think. - M2.2

This was often the first time the idea of gendered parental expectations was raised; particularly the idea that girls should be *bunkei* (humanities-oriented) and that it was boys who were *rikei* (STEM-oriented). This idea forms a core part of the next chapter. Thus far we have seen teachers talking about society generally, and parents; which is exactly what we would expect considering that teachers felt that socialisation (especially childhood play) was such as core cause of the gender gaps.

These kinds of actors, and the sorts of solutions teachers recommended they implement, are out of teachers' direct control. TO.1 had been clear that the gender gap was caused by cognitive (brain) and interest differences, themselves (in turn) caused by childhood play. This thought seems to have been percolating in the intervening quarter hour before we finished the interview, as when he was asked whether he had any further comments, his first thought was that the situation could be set at a very young age. He clarified that this did indeed make it something difficult for a school to address – by the time a girl arrives at middle school it may be too late.

> To think about [middle school]...there's a proverb here in Japan: 'the soul is the same at three as a hundred'(*mitsugo no tamashii hyaku made*). By age 3 things are pretty fixed – there's a proverb with that kind of view. So, in the end, I'm

> thinking why there's such a phrase, but it's kind of true. To a degree, by age 3, it's decided.
>
> [Interviewer: that's early. Not something school could address, do you think?]
>
> No, they can't. Yeah, that kind of problem is more about the home environment fixing things, to a certain degree. Kids who are exposed to many things are interested in many things but…but that environment...it's complicated. What's good and what's bad, I don't know – it depends on the child. – TO.1

> And that's because when they were young…I wonder…from when they were really young. It's not like 'this' is the cause, but girls are, if I had to say, more likely to understand/downplay, while boys are more 'stand-out' [Interviewer: *mitsugo no tamashii?*] Yeah. [*laughs*] From when they're in kindergarten-ish. That personality lingers. – SH.2

Society (including parents) have the lion's share of the responsibility for fixing the gaps, according to teachers. However, as we saw in the previous section on raising interest and confidence, this did not mean that teachers saw themselves as having no part in a solution – in fact, teachers considered themselves next up for taking responsibility. Considering that teachers had so many ideas of implementable solutions (particularly for confidence problems) this is not too surprising.

Teachers were not fond of the idea of putting responsibility at the school administration level, mainly they saw it as a teacher's individual responsibility to help fix the gaps. A few teachers were explicitly uncomfortable with the idea of implementing school level policies, worrying it would be discriminatory, or even simply ineffective, compared to what they could do themselves.

> …that is……teachers and students I think…so…I feel like the country doing something would be the wrong approach. [Interviewer: at school?] Actually, as a school, teaching 'let's shrink the gender gap' I wouldn't express that. Actually, I think it would be the opposite and it would become gender discrimination – I get that feeling. If you really want to shrink the gap then I think individual teachers altering their lessons might be better. - Z14.5

> Well, I think in the end the people who are teaching are the ones creating the environment. Like, making an environment where it's easy to ask questions… - SK3

> I think there's a lot of teachers who don't really understand how to teach maths in a way that's relevant to the real world. Me myself, I'm always thinking about how do to that. If we can raise teachers' ability to do that, that would help….and if they understand the boy vs girl thing things might change – B2.3

TO2.1 had been emphatic that the gender gap could not be fixed because it was due to biological talent imbalances between men and women. Despite this, she also made it clear that teachers were (after parents) the ones who held the most responsibility for fixing it – and had plenty of suggestions for how to do so.

> Well, that depends on the teacher. Teachers, it really does depend on the teacher…School teachers are, for students, people who exert a huge amount of influence I think. Next to parents I think, if you're blessed with a good teacher you work hard. If you don't fit with that teacher you quit etc. - TO2.1

Overwhelmingly, teachers did not think it was the Ministry of Education's (or any other part of the government) job to fix the gender gaps in mathematics. A couple of teachers were outright dismissive of the idea. According to teachers, the government's potential role was limited to how they could better enable teachers to take action by raising awareness – even then, this was not a common opinion.

> It's difficult to say to the government: 'make them do this'. It's a school-level thing - Kids are humans, so you can't just apply the same rule to everyone. Everyone is different. So it's going to be difficult to make a suggestion on that country/governmental level and say to teachers 'do it like this' -SB1

> The ministry… they can say to 'do that' , but reality if it's not coming from teachers then I'm thinking it wouldn't really work. -M1.3

> So first off they [teachers] need to know…mass communications, and the media needs to do the same…for the government, NIER could start by doing some PR…that's what I think. – M2.1

There were more teachers who expressed the view that it would have to be a team effort between the different groups mentioned, than who put the responsibility on the government directly. Only one teacher (Z14.1) thought it was solely individual pupils' responsibility, saying "Particularly…I think it's the kids themselves problem".

> Well, that's various things. We as teachers have responsibility, parents who are raising kids also have responsibility. The education system…the MEXT also has some responsibility, I think. Then also, the various schools in the education system, um, I think there's related points in the management of that too. There's various [groups with responsibility] I think. – M1.1

> It's probably…the responsibility for solving it…I wonder…It's something that needs to be done in a lot of places…and the importance……there's a lot of noisily talking about women's societal progress, so within that the people who are involved in women's employment would, in that way, pick up on that…it's not just about education it's also on the societal side so if that was taken up then perhaps…from the work side they might pick this…and if there's awareness then the numbers of women might increase… - M1.3

Interestingly, no one brought up universities as having any role to play - even though we will see in Chapter 7 how powerful their involvement could be. And no one brought up the idea of lesson-study groups, school level solutions were also unpopular. 'Society' was the most important player, followed by (and somewhat including) parents, and then teachers themselves as individuals. Teachers were not supportive, in general, of the idea of schools or the government getting involved, and teachers did not tend to blame students for their situations either.

6.4.4 What does this mean for teachers' perceptions?

This chapter argues that part of the reason behind teachers not (consciously) recognising or problematising the gender gaps rests on what they believe are the causes, and whether they believe that there is anything that could be done about them. Seeing that teachers placed such an emphasis on 'inevitable' or innate causes, we could expect them not to feel that the gaps were fixable – yet we find that, although this is true, it is not the whole story.

> Yeah. I think so. Like I said before, brain differences…if there are brain differences then we won't be able to change it. The difference between men and women. From that biological perspective, then from the moment you're born boys and girls are set, there's that aspect. Then I think there would be things that can't be changed. I think so. But I think it's possible to think of ways to fill in that gap. - B1.3

A stronger emphasis on strictly biological or inborn characteristics did seem to make the idea of fixing the gap less likely (or at least not fully possible) for teachers. But even then, we saw that teachers like TO2.1, emphatic that the gap was caused by innate differences and therefore could not be fixed, could still think of ways to improve key causes of the gap such as girls' lower interest or confidence – as long as this idea was detached from the concept of 'fixing the gender achievement gap'. Meanwhile, a notionally non-innate factor like interest differences (which the majority of teachers could think of a way to improve in girls) might be enough to put the gap in the 'unfixable' category for a teacher like Z14.1 who said "if the cause of it [the gap] is because boys have more interest in maths then…then there's not much we can do in terms of teaching…that's difficult". In this way, the actual impact of causes on teachers' recognition and problematisation seems to be a division between teachers who see the causes as inevitable or unmodifiable – regardless of whether they are caused by innate factors or by the social environment.

Section 6.4 establishes that teachers can see ways to improve (even if not outright fix) the gender gaps in achievement and attitudes. When the focus was narrowed even further to ask teachers about solutions to specific problems – namely confidence and interest, things that they themselves have identified as crucial traits for success and that a lack of which is likely contributing gendered achievement differences – the answers were detailed and practical. Many of these suggestions were things that teachers themselves could implement. Indeed, we saw that teachers placed a lot of the responsibility for fixing the gender gaps on their own shoulders.

Looking at this, we might expect to see teachers problematising the gender gaps. However, the reality is more complex. In a portent of things to come in the next chapter, this section also reveals a mixed reaction to the idea that it is necessary or desirable to eliminate the gender gaps, and there was little support for the idea that it would be fully possible to do so. Broadly, teachers' views on responsibility for, and the ways to fix, the gender gaps mirrored their opinions on the roots causes – and a large part both lay well outside teachers' sphere of influence embodied in 'social change' and things like early childhood experiences of pupils that they would not meet until years later. With such uncertainty about the feasibility and desirability of fixing the gender gaps, and the variability of how teachers conceptualised their own role, it is less surprising that teachers have not problematised the disparities.

It is clear from these interviews that there is a wealth of information that teachers would be able to share with each other to develop solutions, but that something is holding them back from being able to do so.

6.5 Conclusion

6.5.1 The Three Main Barriers

Teachers see a difference between 'being good at mathematics' and' being able to get good (enough) grades'; tied to this, we see that teachers think of girls in one way, and the ideal mathematics student in another (very different) way. Although teachers describe girls in positive terms such as 'diligent' and as 'steady' workers, these traits are not the skillset teachers say is most necessary for developing mathematical thinking and the ability to apply knowledge in new and unfamiliar situations. Instead, those characteristics are ones that teachers perceive boys as having. Teachers pegged the causes of the gender gap (including the large PISA gap) to factors such as girls' comparative weakness in applied mathematics, and lower interest/confidence in mathematics. In this chapter, the picture teachers paint of this process is that girls' temperament (Theme 1 personality) and abilities (Theme 3) are not geared towards mathematics that goes beyond what you would find in textbooks or would be covered in class. Many teachers see girls as

taking an approach to mathematics that does not help them develop the skills they would need for more complex or applied mathematics. We do get a hint of the other side of teachers' explanation, which we explore in the next chapter, that perhaps girls simply have other priorities.

These explanations that teachers give for the gender gap in achievement draw upon the differences noted in the themes of Ability (Theme 3), and the Personality differences that feed into them (Theme 1). For example, the flexibility and conceptualising power in mathematical thinking (Theme 3) that is developed through having the curiosity and confidence to spend time solving problems and not being deterred by setbacks (Theme 1). Something that needs further exploration is: how can hard working girls who, by all accounts, care about their work and are anxious enough about being wrong that their methods end up backfiring on them, also be perceived as being uninterested in mathematics?

In the previous chapter, we saw a majority of teachers start their interviews saying that there was no gender achievement difference between boys and girls - something true even for teachers who went on to report behavioural and attitudinal differences that they describe affecting achievement. This chapter investigates how both of those things can be true at once: how teachers can know differences, but not conceptualise them as such at first, and what could be blocking that recognition and/or problematisation. There are three main components identified in this chapter: credentialism, teachers' perspectives/lenses, and whether the causes were considered inevitable or modifiable.

Credentialism

Teachers may prioritise measures such as termly progress tests and classwork grades over (or to the exclusion of) others when considering whether there are achievement gaps in their classrooms. We have seen teachers explain that girls can do very well in mathematics if it is something like a test, with clear parameters to revise and practice, as opposed to struggling on new or applied mathematics.

Not only would these measures be some of the most obvious and quantifiable, but teachers would have sound reasons to think of these as the most important metric. There is a strong streak of credentialism in the Japanese education and job-hunting system (Kariya 2010; Kariya 2018), and it would be logical for teachers to prioritise a measure of how well a child is doing based on the curriculum. However, this deemphasises and conceals gender disparities in other areas; such as the gap in the ability to apply mathematical knowledge – the sorts of mathematics skills necessary for more advanced stages, STEM jobs, or for doing well on PISA tests.

Although there are sound reasons to focus on measures like classwork tests, where girls tend to do better (according to teachers), using this to judge whether there are gender achievement differences is complicated by the fact that teachers are operating with imperfect knowledge. Very few teachers were working directly from the data for the interviews, with everyone else relying on their memory of pupil performance.

Awareness, Perspectives, and 'Lenses'

Even then, actually *seeing* gender disparities as gendered is also determined by the perspectives – or 'lenses' – that teachers use to regard their situation - particularly gender. The clearest example was found in how even classwork/progress test score differences seem to reverse or widen throughout middle and high school. Yet this is not necessarily noticeable unless you compare across year groups and ask whether the boys and the girls are changing differently. Unless you think to look you will not see. However, teachers can seem reluctant (or that they have been discouraged from) using a gendered lens to look at their classrooms.

Japanese teaching has included two prominent values over most of the last century: prioritising treating children the same, and a more recent innovation from *yutori kyoiku* which holds that children should be seen and treated as individuals first (Okada 2012; Kariya 2013a). Neither of these approaches leaves room for considering demographic differences such as sex, and we will return to the factors behind the aversion to using a gendered lens in Chapter 8.

The difficulty of this can be seen again with the 'change over time' difference – one of the most reported gender achievement disparities. Teachers in this sample were assigned to different year groups, and even different ability streams within these year groups, and these seem to shuffle every year. This structural/systemic feature of the education system, and how teachers work within it, could be helping to obscure this change by leaving teachers with a fragmented picture of what is happening - thereby reducing problematisation. The fact that so few teachers use a gendered perspective is likely the biggest culprit, but this structural feature of the Japanese education system is unlikely to be helping. If teachers cannot recognise the gender gaps, then there can be no problematisation.

An Impossible Cause?

Finally, this chapter asks whether the (root) causes that teachers attribute to the achievement disparity are affecting their recognition and problematisation of the gap. We saw that teachers' reasons fell largely into innate and non-innate categories, and although innate causes could have presented a bigger problem, it was really how inevitable and unmodifiable (unfixable) a teacher felt a cause was that mattered. This led to a situation where some teachers felt that inborn brain differences could be worked with, and others did not; and where a teacher could find socialised interest differences insurmountable, but another could see an opportunity for change.

The root causes of socialisation and biological/innate differences are largely out of teachers' direct control: a teacher in middle or high school has no jurisdiction over how a parent raises their toddler, individuals cannot change society wholesale, and (presumably) no one can alter biology. It would therefore be understandable that there is little problematisation and mobilisation even were there to be wider recognition of the disparities. After all, if the disparities are made up of factors woven into the fabric of society – or even into our biology in the case of innate differences – is it something that would even register as a gender *gap* (as in something that might be detrimental, that may not have to be there) rather than just 'how things are'?

However, there is indeed support for the idea that it might be possible to reduce the gender gaps – even if completely eliminating them may not be possible. Moreover, when asked directly for their input on addressing a specific, smaller part of the problem that they identified (confidence and interest) teachers had many concrete suggestions. Teachers gave actionable solutions, most of which were things that they themselves could implement. This was also reflected in their answer to whose responsibility it would be to tackle the gender gap: teachers feel they have an important role. This suggests that teachers need to be given the opportunity to pool their knowledge and ideas to implement solutions; the lack of recognition and problematisation of the gender gaps is likely a serious barrier to this. The plethora of possibilities that teachers suggest lends credence to the idea that their views and proposals for change could (and should) form an important part of designing and implementing a solution to the achievement gender gap. After all, teachers are renowned for their power to affect change from the bottom up at the grass-roots level (Isoda et al. 2007; Takahashi 2017).

One potential wrench in that plan would be how, although teachers suggested individual level solutions that they could implement, most seemed to have an aversion to the idea of even school level policy change – let alone a top down national solution from the government. Teachers did not bring up the possibility of lesson study or inter-school groups, or any other collective solution to the gender gaps. SB1's school had noticed and problematised the gender gaps in their own school and called a meeting to discuss it – however this never went any further than that school and how it was resolved remains a mystery. What could have been possible if that intra-school discussion had become an inter-school dialogue? In lesson study, Japanese teachers apparently have a powerful avenue for change at their fingertips, yet lesson study did not form part of solution for interviewees – including for those teachers who regularly attended such things.

This chapter has focused mainly on those gender differences, and the reasons for them, that teachers identified in Themes 1 (personality) and 3 (ability) and how they interact: how mathematical thinking and the ability to apply prior knowledge to new situations is developed,

and how girls are falling short of the ideal of a perfect mathematics student. We have seen how teachers' awareness of the gender gaps could be thwarted by a combination of inattention to gender and/or by rationalising it away, how teachers are divided on whether it is possible (and how) best to solve the gaps, and we have seen how a drive to get children through the curriculum may de-prioritise other important metrics to measure how girls are doing relative to their male classmates (credentialism).

However, we also have clues that this cannot be the whole picture. Teachers did think that liking mathematics was an important component of being good at mathematics, and they ranked girls' lack of interest in the subject as one of the most important factors behind the PISA gap. We also saw a seemingly contradictory description of girls both as dedicated students who were anxious to do well, and as bored and uninterested in mathematics. In the next chapter we will consider these arguments, particularly credentialism, from a new angle – drawing instead on the differences identified in Themes 2 (interest) and 4 (choice). In this chapter we have made a start on the 'could we fix the gaps' aspect, but the pressing matter of 'should we fix the gaps' remains and will form a key part of the next chapter.

6.5.2 Next Steps

Chapter 6 focused on how teachers' differing perceptions of girls' and boys' mathematical abilities (Theme 3), and the personality (Theme 1) characteristics that feed into them, affect their recognition and problematisation of the gender gaps. Chapter 7 highlights the other two themes – interest (2) and choice (4) – and how they influence teachers' interpretations of disparities between their male and female students. In Chapter 8, we delve into the underlying culture of silence on the gender gaps and how it hampers discussion and problematisation.

Here we explore how structural features of the education system and Japanese society can help hide the gendered nature of achievement and behavioural/attitudinal disparities, and block problematisation even if they are noticed.

An Illusion of Choice?

In Chapter 7, we observe the sway that the deeply embedded and normalised *bunkei/rikei* track system (B/R system) holds over whether the gender gaps in mathematics are recognised as such, and whether they become problematised. The element of (ostensible) choice for girls that the B/R system introduces, and teachers' perception of girls' agency, reduces the incentives for teachers to problematise achievement differences that are hiding in plain sight. Do teachers feel they are able, or entitled, to interfere with girls' choices?

In Chapter 6 we saw girls described as taking an approach to mathematics learning that is inefficient, or even detrimental, to being successful in mathematics. In theory, steps could be taken to correct these approaches (and the resulting weaknesses they cause) and make headway into resolving the achievement discrepancy. This chapter looks at some of the reasons that could disincentivise doing down that route: that girls are taking the right approach *for them*, and if so, should you (could you?) interfere?

Culture of Silence

In Chapter 8, the final empirical chapter of this thesis, we discover what teachers themselves think is behind the silence on the disparities between boys and girls in mathematics. We also explore how genderblind ideals and taboos affect recognition and problematisation of the gender gaps. In this issue, there is a lack of communication, trust, ad cooperation between levels of actors who could do something about the situation; we cover issues of latent knowledge, information suppression, and how these interact with genderblind ideals.

Chapter 7 – Choice and the *bunkei/rikei* Track System

7.1 Introduction

Over Chapters 5 & 6 we have seen that teachers think of boys and girls differently, including in ways that they understand to affect achievement. In Chapter 6, the themes of personality (1) and ability (3) were in the spotlight. This helps to explain why so many teachers see differences between their male and female pupils, and yet so many teachers' initial reaction was to say that there were no gendered achievement disparities in their own classrooms. In what we will dub here as the 'Good Girls Don't Get Ahead' view; the impression given in this first branch of explanations for why girls do worse in certain kinds of mathematics, boils down to teachers feeling that girls use a suboptimal approach to their studies, despite being dedicated students.

However, this is one side to teachers' understanding; there is another view interwoven. Building off the framework established during Chapter 6, we will probe an alternative viewpoint which foregrounds the other two themes of interest (2) and choice (4). Although not in the spotlight in Chapter 6, the idea that teachers see girls as uninterested in mathematics, unless it is part of a required test, played a part in that explanation too.

Also in Chapter 6, we encountered some of the key impediments that teachers face in recognising the gender gaps and problematising them. One impediment is that the lenses that teachers use affect whether they identify gender disparities. We saw that, for many teachers, it was not until they were asked to compare across years, keeping gender in mind, that they recognised the achievement disparity that appears over time. We also saw the potential impact of another impediment, credentialism, on teachers' views. Teachers seem to value and prioritise achievement in different kinds of mathematics differently, and that this might mean they overlook other ways that girls are struggling with mathematics as long as their overall grades are good enough. We also introduced the idea that the perceived intractableness of the gender gaps not only affect what is seen as constituting a gender gap, but also block teachers from

problematising them. These three factors blend together again to form a core part of the story in Chapter 7.

The sorts of behavioural, attitude, and grade differences described by teachers in the previous chapters intensify as children move through the school system. In this chapter we consider how the nature and embeddedness of the *bunkei/rikei* system (B/R system) can conceal the scale and gendered nature of these differences from teachers. We will examine this system of separating children into STEM-track and humanities-track classes, and how the gendered nature of this split can be overlooked as teachers interpret it as the result of rational choices made by students. In this way, we can reflect on whether (and, if so, how) this may be affecting teachers' recognition and problematisation of the gender gaps.

In Section 6.4.1, we saw that a substantial group of teachers did not think that the gender achievement gap needed to be addressed: the status quo was fine – not just because the gaps were seemingly inevitable, but because they are not necessarily a problem anyway. This chapter illuminates the environment that teachers work in which may lead them to feel that way. We document teachers' perceptions of the B/R system, and aim to uncover the tension between the agency of girls' 'choice' within the structure of the B/R system. The structure *is* constraining girls' choices, according to how teachers talk about it, but it is generally not interpreted as constrained enough to overwhelm the perception of girls' agency. Instead, choice is emphasised and is what overrides the recognition and problematisation of the gender gaps.

Teachers' explanations in the previous chapter framed girls more as being acted upon, rather than as actors in their own right. Here, agency is the star, even while the constraints inherent in the B/R system itself also affects teachers' interpretation of the gender gaps in achievement, behaviour, and attitudes; and, therefore whether these differences are problematised or not.

7.2 Strategic Girls and the *Bunkei/Rikei* System

In Chapter 6, we theorised that credentialism blocks both the recognition and problematisation of achievement disparities, as some teachers prioritise a curriculum/test based metric over other measures of achievement. At face value, that kind of gap may not be considered big enough to cause concern. We could summarise this thinking as: 'girls are doing well enough, so what is the problem?'. Thus far missing from this dynamic is teachers' perceptions of girls' agency and girls' own credentialism: what teachers think their female students prioritise as important and why they do so. Here we can modify the above statement to 'girls are doing well enough *for what they want to do*, so what is the problem?' Girls are seen as satisficing: doing what they need to do to do what they want to do. Chapter 6 leaves us some clues that this angle warrants consideration of its own.

Teachers emphasise girls' lack of interest in mathematics as a primary cause of the PISA gender gap. They also explained that interest plays at (least a supporting) role in the development of the mathematical thinking skills teachers emphasise as important for getting good grades in mathematics. We also saw that girls' lack of interest is a complicated topic for teachers. They were less confident concerning how to go about rectifying girls' lack of interest: connecting mathematics they were doing at school with the 'real world' was the primary proposal, but there was a dearth of suggestions of how to do this for girls.

Something that many teachers *did* feel that girls had an interest in were Tests and their own grades. A common belief about girls that came up when discussing approaches and attitudes towards mathematics, was that female students are only concerned with the mathematics that they would be examined on.

> Whether it's at this school or my school I was at part time…the students who would voraciously tackle questions, there were more boys. There were quite a few girls who were like that too but…but comparatively they were quick to give up 'eh, it's ok. It's not really that relevant' or 'it's not on the test' there were a lot of that kind of girl. – KHW

> I think middle school girls aren't interested in maths. I mean, they're interested in their grades but... - X4.2

This view that popped up amongst both teachers and researchers; and was often framed around girls not intending to continue with mathematics after it is no longer compulsory. Girls would therefore only be concerned with what mathematics would be on the tests and exams that get them past that stage.

> Girls, of course, don't really like thinking about maths really. So, if they can do maths reasonably well, then after that they go into a world that doesn't really have anything to do with maths. They think ' I want to go into *bunkei* ' so…the students who like maths, of course, they'll think it through to the end I think, but...mostly those kids who [do *bunkei*] aren't really interested in maths so...they don't want it that much I think. So, 'if your path isn't *rikei* then work hard [on *bunkei*] that instead' that's what I think. - T.1

This is important because it introduces elements that shift how the gender gaps can be conceptualised and, therefore, whether they become problematised: interest, and choice.

Girls struggle with mathematics application, according to many interviewees. Teachers feel this weakness is another of the major factors behind the PISA gap, noting that girls do not respond as well to mathematics tasks and questions outside the scope of what is taught in class. In Chapter 6, we learnt that the act of taking prior knowledge and applying it to new or complex mathematics questions is not considered a strength of female pupils. In the branch of thinking we explored in the previous chapter, girls are either not as capable as boys, or are using a suboptimal strategy that will not allow them to be truly good at mathematics regardless of how diligent they are. Likewise, many teachers interpreted the achievement gap changing over time as a function of boys' physical/mental growth or boys' motivation increases due to entrance exams. In each of these is the underlying assumption that boys are better at mathematics – boys would inevitably catch up or overtake. Girls were passive in this process, working hard but getting nowhere.

However, the knowledge that so many teachers see girls as motivated by exams changes this picture with the addition of agency – or, at least, teachers' *perceptions* of girls' agency. This, in itself, creates another hurdle for problematising the gender gaps. In this view, girls are not falling short of standards because they are trying and failing, but because they are choosing not to reach them. It is this rationale amongst teachers that we will explore throughout the rest of this chapter. First, we need to establish what exactly teachers think girls are being strategic about, and what benefits this would gain them. Then we will look at how this affects teachers' narratives about gender differences.

7.2.1 The Bunkei/Rikei System

Here we introduce the system that houses the vehicle for this strategic element: the *bunkei/rikei* (B/R) system. First, we establish how and why this system is in place to understand the context that teachers and their pupils operate in.

The B/R system is a track system, usually implemented in the second or third year of high school in most schools. The terms '*bunkei*' and '*rikei*' refer to humanities/social-science subjects and STEM (science technology engineering and mathematics) subjects, respectively. Tracking generally refers to any system of separating students out into different groups. The most common are ability (streaming) and tracking by subject: the former tends to group children of 'similar' achievement scores and the latter separates students by what subjects they take (Nakanishi 1993, p.20). The B/R system falls into the latter category. Although ability tracking has historically been unpopular in Japan, B/R tracking is the norm. All of the Combined and High schools in our sample had this system.

Under this system, students in Japan will take mathematics throughout their school careers; at least in theory, mathematics is not an optional subject at any stage of school. However, during high school, students will be asked to make a choice as to whether they want to be in a '*bunkei*'

or a '*rikei'* track for the rest of their school career. This choice is generally made officially during the first year of high school – but, unofficially, this can take place much earlier; something that is vital for our understanding of teachers' perceptions. An estimated 80% of students have chosen by the time they get into the 1st year of high school (Kawaijuku 2013, p.12). More than 40% of students have decided by their middle school years (Benesse 2015, p.2). There is usually some consultation with teachers to help with this decision, but ultimately it is up to the individual student. *Bunkei* or *rikei* is a major decision for students. The existence of vocabulary like *bunten/riten* 'turn to *bunkei/rikei'*, and of endless websites, forums and YouTube videos helping students to pick between the two speak to this.

The gravity of this choice lies in the fact that it is expected to correspond to university plans, including which exams a student wants to register and prepare for. Although the focus of this thesis is at the school level, we must jump ahead to look at the university entrance exams to understand what environment teachers are operating in at this prior stage.

Getting into university is a complex process: entry routes are many, varied, and ultimately up to individual students to navigate. The process is different depending on whether the student wants to go to a public or private university, or to compete using 'standard' exams or through a recommendation system. It also depends on what subjects the student intends to take. Each university designs and publishes its own entrance methods and can change these at will. Every university must be researched and applied to individually and their testing fees paid – introducing extra risk and opportunity cost. Public universities require the student to take a 'Centre Exam' which includes mathematics as standard, but private ones do not – but most private universities, especially elite ones, will take those results into consideration, depending on which entrance path the student chooses. Public universities want to review the student's performance in all subjects while private schools will tell them which subjects they want.

Those aiming for a *bunkei* subject at private university may not need any mathematics at all; and whilst those who are aiming for an elite private *bunkei* university may still need it, it may not

be to the same level as someone going to a public university (even for the same *bunkei* subject). A student aiming for a *bunkei* subject at a public university will, in contrast, expect to be examined on mathematics. The result of all of this is a system that is both flexible and complicated, and covering it in detail is outside the remit of this thesis. However, we must understand that it requires a student to be organised and *strategic* to navigate it successfully and maximise their chances of getting into what subject they want, where they want. There are serious opportunity costs, both financial and time, in making certain choices. Wrong choices could be very costly indeed.

What relevance is this to teachers? Classes during high school will be split at some stage into the *bunkei* and *rikei* streams. Teachers must prepare children for the university entrance exams, so the content and focus of the lessons will be determined by whether they are *bunkei* or *rikei* mathematics classes.

> But maths is…if you're aiming for national universities then of course their exams have all subjects in them. Even for *bunkei*, you have to do maths. Of course, then to a certain degree, the maths is…the bare minimum is what you do. You can take more as a 'plus alpha' but…so I took *bunkei* too as I did everything [on the *rikei* track], but it was the bare minimum. There are kids who are going to national universities, and as the national universities have all subjects they require all subjects. And in that case it's about doing *more* maths, that kind of thing. Yeah, they're split. The maths in bunkei gets easier, it's *really* easy. Like, the teachers will be like the same as middle school ' The test will be this kind of thing, everyone! ' –T.1

> In Japan there's a system whereby maths doesn't have to be important. If you're aiming for a top public school - Tokyo…Kyoto university etc - then maths is important even for bunkei. But for Waseda, Keio the top private universities, then you don't have to do maths. Language, English, History…you can just take those three. So there's a lot of kids who just don't really study [maths] in third year. - BH.Y

The specifics vary between schools. *Bunkei* mathematics classes in some schools can be of comparable rigour (although incorporating less content) to *rikei* ones, while others are, essentially, repeats of the middle school curriculum and approach. Generally, it seems that *bunkei*

mathematics classes are considered 'easier' than *rikei* mathematics for most schools, with less content and often a different teaching approach.

Thus far, we have explored the role B/R tracking plays in the Japanese education system, and why this affects teachers (certainly those who teach at the high school level). We shall also argue that it affects those who teach at an earlier stage too. The reason that this is relevant for us is that the system is highly gendered.

7.2.2 Girls are *Bunkei* and Boys are *Rikei*

Teachers paint a clear picture of who takes which track. Few girls will choose to go down the *rikei* route, and many teachers see the few who do so as having different motivations than boys. The teachers who currently teach B/R split classes had very few girls in their *rikei* mathematics classes.

> Yeah, it's clear by that point. They're divided into bunkei and rikei and there are less girls who are rikei. Like, 10/15 people in a class of 70 or 80 are STEM, so 10%ish. -TO.1

> So in my third year class 70% are boys 30% are girls, and that 30% are very good at mathematics. - BH.Y

Even those teachers who were not currently teaching B/R split classes commented on the extent of the ratio skew from their own experiences. Although two of the older interviewees commented there were more girls in *rikei* these days, the numbers their younger counterparts were citing do not seem to reflect any radical change.

> There were only a few. Um…in my year, and I was in maths, but in the same year there were 120 people and 8 were women. In the past…now it's increasing, but in the past *rikeijo* [STEM girls], in my generation, there weren't really any. But now it's steadily changing a little…I think…in the past there were even fewer. - T.1

> When I was in middle school there were not a lot [of girls in rikei], no…there were only 18 students in my year and there were 10 girls - they were all bunkei. - KHW

> …but when that happened the '100% rikei humans' were all male. So out of a class of 34 there was, including me, there were 31 boys and only 3 girls. - X4.1

It cannot be emphasised enough how gendered the B/R split is in society, and how aware teachers of this as a fact. The idea that 'boys are *rikei*, girls are *bunkei*' is so deeply ingrained that every teacher and researcher interviewed alluded to this idea in some way at least once – and it is the biggest collection of codes in the database.

> Somehow, looking back at my previous experiences, my life so far, somehow my image is that boys are good at things like science and maths and social studies or literature is something girls are good at. Somehow, I have that image… -Z14.5

> It's a societal feeling that boys are *rikei* and girls are *bunkei*. And if you look at researchers then, of course, Nobel prize winners are mostly men. So it's like 'that's the kind of society that men go into' you get that feeling…it's a societal thing…not just maths but *rikei* more broadly it was not permitted in the past for women to really follow that through, instead it was men who went to university and saw that through. That's a societal thing…even now if you look at universities, they go to university but it's expected that those going on to grad school will be men…that societal feeling is that men are *rikei* and women are *bunkei* - X4.2

Girls who choose (and/or are good at) *rikei* are seen as so unusual that they have their own word – リケジョ (*rikeijo* or 'STEM Girl') - to describe them. Many teachers and researchers brought up this word, explaining that its existence communicated how these girls were thought of.

> Society's atmosphere, trends…there's this current that 'boys are *rikei*, girls are *bunkei*'…don't you think? Like 'Wow, girls who can do maths!' makes it feel like a rare thing. - X4.2

> Yes, it's marking women as 'rare cases'. That is an influence of the environment. Women who like maths are considered strange or odd. In Japan they are viewed as weird. It's the same with science, not just maths. - GS.R (Researcher)

> So, recently…have you heard of the *rikeijo*? [Interviewer: yeah] ' rikei girls ' being called that is because of the whole ' girls are bunkei' thing and these [rikei girls] have been especially picked out – because there's fewer of them, when we look as a whole. That feeds into our fixed ideas - Japan as a whole is like this- …'boys are comparatively born to be good at maths, and that they like maths more, and that they find it more fun'…and 'that boys like blue clothes, girls like pink'…it's the same as that. That's…'girls are inherently not good at maths' - BH.Y

It was not lost on the female teachers that they too were unusual for liking mathematics and choosing to continue studying it. Much like the male teachers, they said they went into their jobs because they liked mathematics at school. Unlike the male teachers, they were also aware of the fact that this was rare amongst their peer group. Female teachers had mixed feelings about this, with most were either pleased or neutral about standing out from the crowd, but all of them found it important enough to comment on.

> Well, because I'm a woman…that…'why can I do maths, I couldn't do bunkei-type things like language or social studies' that kind of thing…I wonder. It's more interesting? Well, social studies is interesting too If you can properly study and understand it but [laughs], but I liked thinking mathematically more. So...the reason for that, the impetus for that…when I think about that I wonder… an early childhood thing perhaps. - X4.1

> My teachers said that…'to go to a famous university, you should do *bunkei* ' that's what they told me – that it was easier to get into [one] if you do *bunkei*. If it's the same university, then *bunkei* is easier to enter with…so…with the girls pretty much everyone chose *bunkei*. But I wasn't good at *bunkei* so I did *rikei*, so because of that I went to a more *rikei* university. - T.1

Bunkei and *rikei* are seen as distinct, mutually exclusive, paths and this polarisation maps onto gender. This is particularly interesting considering that, in most schools, choosing one does not actually mean that you stop (officially) studying the other. Nevertheless, they are considered

so in part because the system splits into two tracks, and in part because the decision-making process between them is so heavily dependent on rejecting or embracing the other – something we explore later in this chapter.

The polarisation is also seen in how often interviewees juxtaposed mathematics with classic *bunkei* subjects like *kokugo* (Japanese language) or English. More than half of the interviewees made a comparison like this. Although this is the case regardless of feelings about the achievement gender gap and stance over whether it could be fixed, we can also see echoes in this tendency of the idea of 'balance' encountered at the end of Chapter 6 (whereby teachers felt the gender gap was fine because of this balance); many teachers would explain that girls were much better at these other subjects when they discussed achievement disparities in mathematics.

> I feel like there's a lot of female students who aren't so good at mathematics. Well, that's limited to mathematics though! When it comes to other subjects, for example *kokugo* and literature when you're reading and writing things…there's a lot of cases where girls surpass [boys], then…for example…this is a societal example, but when you're putting on an event or something like that then the tendency is for girls to become leaders [laughs] around 70% are girls who are in charge, the leaders. Boys follow their orders…[laughs] but if you're only talking about studying then boys do a little better. BH.Y

> Yes, for the entrance exams. Even though girls are working their hardest, in the end it's the boys who are rewarded. That's just maths though, for example with English then that diligence pays off for girls. – TO.1

> There aren't many in maths are there? But there are subjects where there are more women aren't there. Therefore, in schools…it's like it's perfectly fine state. Like in English there are more women, right? Japanese is also comparatively more…science is about half/half I think, and then there's more in music, and then in art too. So as a whole…even though there's less in maths there's balance in that it's about 50/50 in the end. – T.1

Teachers know, and arguably participate in, this kind of gendering and it clearly affects how they view what is going on in their own classrooms. Teachers know about the broad societal views of gender and B/R; and many see these not just as simple reflections of reality, but as in and of themselves. The stereotypes come from the reality, but the stereotypes also exist

independently of the numbers themselves – they have a life of their own and it leads to the B/R tracks being seen as predominantly for one sex or the other.

We now know that teachers see the B/R system as an ingrained part of the education system, and see it as highly gendered – both in reality in terms of which sex takes what, and in how stereotyped it is. We can also see that teachers feel it affects their students. Close to half of the teachers commented that whether a pupil was studying, or intending to go on to study *rikei,* impacted their motivation – including a few of those who were not currently teaching B/R split classes.

> Once they're in around the second year of high school and they're separated by *bunkei/rikei* then the number of girls reduces…you still have to do maths in *bunkei*, to a degree, so then the *bunkei* kids have a kind of 'ugh this is a drag' but with high school the level is higher, compared to middle school. -Z14.2

> So…the first and second years learn all together. The grades gap gets a little bigger, in second year compared to first....So, for example, you've got girls in these classes who have already decided that they're not going on to *rikei* so the importance of maths, for example for the entrance exams, drops. During second year is when you know that and then you don't put much effort into maths, that's one cause of that [the gap] I think. - BH.Y

These teachers see the B/R system as influencing pupil behaviour and attitudes towards mathematics: that students who are not/do not intend to pursue *rikei* are less motivated in mathematics. Teachers referenced the B/R system directly (as above) in this explanation, and many more feel girls tend to only care about tests and exams. The B/R system's effect on the gender ratios is therefore acknowledged openly by teachers.

We have established that teachers view the B/R system as an influential and important fixture in the Japanese educational landscape. We have also seen that many teachers link this system with its effect on their pupils. Teachers are not simply reporting a collection of widespread cultural stereotypes about men and women, but a reflection of what they really see happening in their own classrooms and which they see as having a real effect on their pupils.

Next, we explore what aspects of the B/R system are affecting recognition and problematisation of the gender gaps in mathematics. The sheer weight of how polarised and normalised this split is makes it hard to recognise how gendered it is - like the proverbial fish in water. Moreover, how do teachers problematise good girls working hard, fulfilling standard gendered expectations of them (by picking the 'girly' subjects), and choosing what they want to do?

7.3 The B/R System, Recognition, and Problematisation

The B/R system affects both teachers' recognition and their problematisation of the gender gaps. The system's features help obscure the gender disparities, and, even if they were to be made visible, make it easy to rationalise them and avert problematisation. One way recognition is made harder is through the separation inherent in the B/R system - splitting off groups into two, *bunkei* and *rikei*, complicates making straight comparisons between boys and girls. Recognition and problematisation are also made harder by the way that the classes are categorised: the split is '*bunkei* and *rikei*' not 'girls and boys'.

7.3.1 The Structure Hides Gaps

The structure of the B/R system itself makes it harder to see gender gaps for what they are. In this simplest form, just having a year group separated into these two classes for mathematics helps to hide the achievement gap. In Chapter 6, we saw that teachers had to make a conscious decision to compare across year groups with a gendered lens to see the 'change over time' achievement disparity; here, they must do the same across the two *bunkei* and *rikei* classes[8]. Not only is making a comparison now more of a more convoluted process, but the purpose behind the class division (a subject choice) becomes foregrounded and overshadows the gendered aspect of

[8] Ability streaming seems to have the same effect. In both cases, teachers had to stop to consider the gender ratios and grade differences in each ability level or B/R.

the disparity. However gendered teachers know them to be, they are still *bunkei* and *rikei* classes – not single sex classes of 'girls' and 'boys'. Instead, to see the gender gap, you must make a conscious comparison, using the gendered lens - something we now know many teachers do not routinely do. We explore the reason why this is the case in Chapter 8.

In theory, *bunkei* and *rikei* classes are not split by measures such as gender, or even by ability. Instead, they are formally split between those who have elected to continue (or not) with those subjects. This also makes the comparator harder to determine: do you compare *rikei* girls just with *rikei* boys? With *bunkei* girls? Not at all? When asked to compare male students as a whole with female students as a whole, the *bunkei/rikei* groupings can get in the way of an easy answer.

Exemplifying this, one interviewee had been very clear that (overall) boys outperformed girls. However, once we got onto the subject of the B/R ratio the answer became more complicated.

> No, not really. The girls who are aiming for *rikei* are considerably excellent, they don't lose to the boys. So there really isn't a big gap there at all. So in my 3rd year class 70% are boys 30% are girls, and that 30% are very good at maths. So there's no gap there. Rather, there are girls in the very top 2-3 students, the one at the very top is a girl. Rather, the girls are a little better. - BH.Y

Even though the substantive answer has not changed (boys, overall, outperform girls), using the lens provided by the *bunkei* and *rikei* classes can make the situation look very different depending on what you focus on. As in Chapter 6, it depends on what teachers find salient. It is perfectly understandable if, when asked about gender gaps in B/R classes, a teacher might say 'no' if they look at their *rikei* class and see girls doing just as well (or better) than the boys, even if there are only a few of them. If they look at the *bunkei* class and see a gender difference, but judge these students by different standards as they perceive them to have different motivations, they could technically be seeing a gap, but is it a *gender* gap?

The achievement gap is harder to access because of how the B/R system creates a division and then provides a 'coverup' of plausible deniability –'it is not a gender gap, it is a *bunkei/rikei*

gap'. Behavioural and attitude differences can also be swallowed up in this way. In Chapter 6 we saw that teachers had a range of ideas as to why girls would lose confidence or start not to like mathematics. When B/R is brought into the conversation it tends to subsume everything else. Hence, we see teachers noticing boys and girls behaving differently, but hesitating to call it a gender difference and instead explaining it (at least initially) as just a B/R difference.

> No, there isn't [a gender difference]. Well…I mean there's more girls in *bunkei*. And now too, third year maths, every time, the kids who are going onto *bunkei* their tension/drive completely drops off. Well, they think 'oh it's got nothing to do with the [university entrance] exams, so from that perspective there is a gap. I don't feel it as much of a *gender* gap though - the *bunkei* kids will of course have their desire drop off. - SH.1

The purpose of the B/R system itself is therefore a major barrier to seeing and problematising the gender gaps, but it is teachers' interpretations of how and why teens are sorted (or sort themselves) into these two tracks that makes problematisation so difficult.

7.3.2 Hard to Argue with a Choice

We have seen how the B/R system can make it hard to 'see' the achievement gender gap, and touched on how many teachers feel that this system affects children's attitudes and behaviours. The way the system works makes it harder to see gender disparities as gendered: it is not a gender disparity, just an expected side effect of children sorting themselves into the two-track B/R system.

As the B/R system is ostensibly a split between those who choose to continue with a set of STEM or humanities subjects, the choice aspect tends to override everything else in people's minds. If the gender gaps are a product of a choice, even if an individual teacher has noticed and is uncomfortable with the gender disparities, is it really a problem? It is easy to see why this could be a stumbling block to problematisation. In teachers' eyes, if girls choose to do *bunkei*, and therefore may have been preparing for and aligning their efforts and motivation even before they

officially choose, this may just be a pragmatic strategy. As discussed earlier in this chapter, entrance for the best universities is competitive so girls may well just be making strategic decisions. Could, or should, a teacher find this kind of behaviour a problem and try to intervene? As the choice aspect is the sticking point for the lack of problematisation, the next question we will answer is what exactly teachers think is behind the choice of *bunkei* over *rikei*.

7.4 Choosing Between *Bunkei* and *Rikei*

Teachers perceive the *bunkei* and *rikei* streams as highly polarised, and that this polarisation maps onto gender. We also know that the official mechanism for sorting students into the B/R system is (theoretically) choice, rather than other metrics like ability or gender. Considering that they themselves noticed how skewed the gender ratios were in mathematics, teachers were asked what they thought motivated students' choices between the two pathways.

7.4.1 Careers

The most commonly cited reasons behind how pupils choose between tracks are to do with jobs and future career plans. These were a mix of positive reasons – like choosing a *bunkei* path because it is a step towards the path they want to follow - and more negative ones such as girls being put off by the male dominated world of *rikei* and therefore opting out.

> Well, whatever you do their interest is tied to their path for university…so with 'maths' to want to study it deeply…where you proceed to afterwards, *rikei* work or *rikei* university…you need a male/female balance. There's a possibility that they'll hesitate over having to go into a male dominated world… So…even if you have interest in maths itself, and study it deeply then you become this or that…it's maybe better to go study social studies, or language, or something language-related – if you don't change that kind of university and society rikei male/female balance, then you won't be able to increase girls' interest in mathematics. - SH.2

Many interviewees, not just those teachers who taught B/R classes, felt that male and female pupils seemed to be aiming for different careers and were operating under different expectations

and constraints. Considering how gendered and polarised teachers described the job market, it is unsurprising that this was the most cited reason for the gendered and polarised B/R track. No teachers were under the impression that girls and boys want *rikei* careers in equal numbers. There was gendered polarisation even within *rikei* itself: many teachers commented that the girls who did intend to continue with *rikei* were aiming for jobs in medicine (doctor, nurse, etc.) or biology (biomed engineering etc.) rather than for jobs in fields like physics, engineering, or mathematics itself.

> …in second year of high school we were split into B/R, but then the *rikei* itself in 3rd year was split into two again like 'The Real *Rikei*'. So, with something like nursing school and things like that, you don't need to really deeply dig into the maths, but it was still something that was a *rikei* profession...so it's B/R but it's *rikei* that's pretty close to being *bunkei* - that's what it was separated into. - X4.1

> But speaking of high school then there aren't a lot of girls saying 'I want to continue on to rikei', there are very few girls. And those that do, they're mostly those who want to do medicine; nurses, or other medicine-related careers. But as for girls and engineering and physics? Then no. - TO.1

> But now, with *rikei*, the number of girls wanting to be doctors or researchers etc has increased. I feel like it's increasing. But, on the other hand, becoming *rikei* because you want to do those kinds of jobs…people like me [who pick maths because they like it] are rare, girls who want to become teachers will generally be *bunkei* - M1.3

Noticing this trend, teachers made a distinction between girls choosing to do *rikei* to facilitate a chosen career, and pupils (male or female) who picked *rikei* for the love of the subject(s). The implication was that girls in the former category see mathematics as a tool, rather than an end in itself. There were no comparable comments about boys. This has echoes of the literature on teachers seeing girls as doing well, but for the wrong reasons (Walden and Walkerdine 1985, p.12). Here, girls are picking *rikei,* but for a strategic or 'wrong' reason.

In Chapter 6, we saw that real-world connection was the most popular way of creating mathematics interest in children. However, no one had any specific suggestions for how to tailor it to girls and a couple of teachers described how the examples that worked with boys did not work with girls and were not sure what to do about it. This is now a little surprising considering we see that quite a few teachers have noticed that girls have a different kind of *rikei* interests. Perhaps the lack of discussion between teachers is the problem here; otherwise, this could have been a part of brainstorming solutions. Researcher SM.R actually suggested that mathematics questions with examples centred around medical scenarios would help reduce the PISA gap by making it relevant to their interests. This could motivate more girls to do the kinds of applied mathematics which some teachers said, in the last chapter, were weaker areas for girls. Those questions are often framed around more stereotypically masculine topics.

Teachers see a strongly gendered division in career choices, and so many teachers say that careers are what motivates children's choices between the tracks. One older teacher had a cautionary tale about encouraging a girl to choose *rikei* over *bunkei,* even if the girl in question is talented and enjoys mathematics. He felt responsible for what happened when a talented female student had gone on to do a *rikei* subject at university, on his encouragement, and she had struggled to find the work she wanted in the *bunkei* job market after graduation. He said he understood that, despite talent and interest, in her case "mathematics wasn't the best choice".

> So, since her graduating, I called that girl. And when I was chatting to her she said "the girls who think 'I'm good at maths, so I'll go and do *rikei'* should think carefully about their path" and then I was like "ah…" I have some remorse about that……so in the end, the subjects you like, that you're good at…still needs to connect with what you want to do in the future. That left a real impression. - SH.1

As a result of this experience, he was now hesitant to encourage mathematically gifted girls to pick *rikei*. Many teachers spoke about the complexities that girls could face in life. A few teachers commented that a girl specialising in mathematics would effectively be reducing her

potential careers down to one: mathematics teacher. WR, another older teacher, said “women who orient themselves to mathematics…can only really end up becoming teachers. So, your job hunting becomes so limited”. Some teachers commented that boys and girls thought about their futures in very different ways: with girls often factoring marriage and children into their plans, while boys never do.

> This is my impression…but girls are more…comparatively…there’s many girls who mix marriage related things into talking about their future, there’s not really any boys who do that. There’s kids who insert marriage within their future path…girls, that is. Also…this is at our school, but, there’s a lot of girls who talk about making a contribution to society. There’s a lot of girls [like that] – SH.2

> There’s a perception, an image, with a lot of people that if you choose *rikei*, then you go to grad school and then continue researching professionally. With *bunkei* there’s an image that you graduate university and then go and find a job. Japanese parents...not so much at this school, but there are parents who feel that way, feel that it’s best for girls to graduate and look for a job and get married. It’s a bit extreme [laughs] but to a degree there's a 'don't do anything difficult' sentiment. So therefore, girls who are like “in the future I want to do this kind of thing” if there are *rikei* role models then they’ll go for that. If there aren’t then they'll go for comparatively…easier? No, that’s not right…that 'it’s fine not to bother with working hard' there’s that feeling. - M1.3

The issue of parents being unsupportive of, or discouraging girls from, (certain) *rikei* paths was brought up by many teachers; female teachers and researchers also talked about their own experiences of this. For the older women, there had been resistance from their parents – although many of them were STEM-trained themselves. Worry over girls’ marriage prospects seemed to be the common theme, even more so if they wanted to go to a specialist university or if they intended to go beyond an undergraduate degree. In Chapter 6, teachers posited that gendered parental expectations may influence what toys and activities children are exposed to, thereby impacting their mathematical interests and skills – long before school. Now the impact of gendered parental expectations affects girls’ choices – this time far beyond school.

Teachers’ personal experiences, combined with the reality they see around them, may also influence their perceptions of girls’ motives and choices. Looking at a mini-case study we can see

how this might work: an experienced female teacher explained she was told to choose *bunkei* to maximise her chance of getting into a good university. She liked, and was better at, *rikei* so went against the grain (and her parents' wishes) to go to a *rikei* university. She thrived, and even felt 'spoiled' as one of the only girls in a mostly male environment. An upperclassman warned her that job-hunting and working for a company was unforgiving for women, and that she should become a teacher rather than go down that route.

> 'It's hard for women to flourish in business…you have to work twice as hard to compete with men. You have to work many times as hard and it's not acknowledged' that's what I was told. Teachers, men and women, are…the same…the salary is the same and in many ways they're equal. And so I heard that and 'ah, yeah. Of course, I'll become a teacher' is what I thought. - T.1

It is easy to see how a strong willed, successful, female teacher who had followed a strategic route might see her own pupils' choices through that lens. She mentioned the system within the first few minutes of the interview. She was also immediately upfront about gender gaps, made an explicit distinction between being good at mathematics and getting good grades, and explained that girls were good at the latter because they worked hard but that boys were the ones with flashes of insight. She was unsurprised at the PISA gap and found it easy to rationalise – it was exactly what she would have predicted – and was only thrown by the fact that it was so much larger than the global average. Overall, her interview gave a very strong impression that she saw girls making a strategic choice to do what they wanted to do. The 'what' was just absolutely not *rikei*. She felt that society had improved, and girls faced fewer limitations, but made it clear in other comments that things were far from resolved. She had made her own choice to go into *rike*i on a very strategic basis, and then seemed to view her female students as doing the same but in the other direction with *bunkei*.

From this section, we can see that girls' future paths, and the choices (Theme 4) they make to get themselves there, were at the forefront of many teachers' minds.

7.4.2 Only Good at One

We have seen how polarised, and how gendered this polarisation is, in teachers' views of the B/R divide. Unsurprisingly, a variation on "I'm bad at mathematics, so I'll pick *bunkei* instead" was a frequent reason for the choice between tracks, according to teachers. For some teachers, it was girls' low confidence that fed into this decision – that they could have chosen *rikei* but did not believe they could. However, for most teachers, it was girls making a neutral assessment of their strengths and finding they were better at *bunkei* and worse at mathematics.

> When it comes to B/R, people often pick based on what subjects they're good/bad at. If they're bad at maths and science then they pick *bunkei*, and there's a lot of girls in particular who do that – that's my impression. So the girls are lower [maths] in these classes, boys are higher. - SH.2

> And in Japan comparatively with B/R, 'because I'm bad at *rikei*, I'll do *bunkei*' there's a lot of those kids. Rather than from the very start wanting to do *bunkei*, it's more 'I can't do maths' 'I can't do chemistry' 'I can't do physics' therefore I'll do *bunkei*. There's that kind of thing. And with kind of thing 'even if you're not good at it, if you like it let's do it' 'Go for it!' Is my thinking. - M2.2

It is noteworthy that teachers saw mathematics as the linchpin of the decision. They are not alone. Surveys and general chatter[9] online show that mathematics -and not other *rikei* subjects - is the deciding factor in the B/R choice. Disliking mathematics, or being bad at it, pushed children (girls especially) away from *rikei* (Kawaijuku 2013, p.2). We can also see this process in reverse: many female teachers describe their own choice to go into *rikei* as motivated by them disliking/being bad at *bunkei*. Only one male teacher mentioned this as part of his motivation, others focused instead on the fact that they liked mathematics. Some teachers were clear that girls could choose *rikei*, and are good enough to do so, but choose *bunkei* instead, as they have more options and can choose what they like out of them – especially if they think they are bad at

[9] See KoukouseiShinbun, 2018 etc

mathematics. Here, we see that choice (Theme 4) is mixed with girls' lower confidence and its effects (Theme 1) on their ability (Theme 3).

> …People are cut out for different things, I think. There's more girls who like *bunkei*, even though they can do mathematics. So…with girls there a lot where even though they can do maths pretty well, they *think* they're not very good at it.- Z14.5

7.4.3 Liking the Subject (or not)

Lastly, some teachers said children of both sexes pick their path based on whether they enjoy the subjects. Some mentioned this in the sense of girls avoiding the 'stick' of mathematics by heading towards the 'carrot' of *bunkei* subjects which they enjoyed more and were better at.

> At the moment, we're interviewing all of the third years and if you ask about their future hopes then there are very few girls who say they want to go into *rikei*. Very low. Numbers-wise, there's 77 girls, but there's not even 7 who want to... who want to go into *rikei*. So even if you get the grades in maths in school… there's really very few that have the sense that 'maths is fun' or 'science is fun' etc - T.1

> Perhaps, due to thinking that maths is getting harder, their interest in maths wavers, for example 'ah English is fine, then'. - B2.1

In the last chapter, we saw that teachers found it hard to inspire interest, (as in intellectual curiosity, enjoyment) in mathematics in girls. We have also seen how important teachers think role models are – girls need to be shown that they have a place in the *rikei* world to be interested. From the fact that pure interest was the least popular reason posited for the split, we can see that it is more complicated than a simple subject preference.

Summary

In this section, we have seen that teachers' primary perception is that girls pick between *bunkei* and *rikei* based on their career prospects, and less because of a genuine interest (or lack of

it). What girls perceive they were good at also plays a role, but a secondary one to the practicalities of future path choice.

The reasoning teachers put forward in this chapter make would understandably affect their perceptions of the gender gaps. If the gaps are the result of the B/R system, and girls' B/R choices are based on rational, strategic decisions for maximising their chances of a successful career in something they are interested in, then we might find it strange if teachers *did* find this a problem necessitating solving. We even heard how one teacher, who might once have problematised losing mathematically talented girls to *bunkei* , even felt remorse after he intervened to encourage a top female student to stay in the *rikei* stream. Problematising girls' own choices seems a tricky process. In the next section, we will see what teachers feel about the system itself.

7.5 'Choice' in Tracking

We have seen that the concept of 'choice' when it comes to B/R is actually more complex than a simple preference between subjects; instead, teachers see it as one with implications and baggage. However, teachers do seem to see it as a choice and respond to the perceived agency in this decision. In this section, we examine teachers' feelings about the B/R system, and compare their views on other types of tracking to better grasp how teachers conceptualise 'choice'.

7.5.1 B/R System

Teachers had mixed opinions on the B/R system. Some disliked it: wishing equal weight was placed on all subjects, or, recognising that people can enjoy different aspects of STEM, that there was more flexibility in choosing subjects. If children had to be divided by subject, then it should be done as late as possible. One researcher had also commented that the B/R system can cause problems for girls who choose *bunkei* but who later might want a job that needs mathematics skills – he saw trainee elementary school teachers struggling with the mathematics in their course after their *bunkei* mathematics classes at school had proved insufficient to prepare them.

> I'm against splitting them. If possible, I'd like students to learn all subjects…as much of a broad an education as possible.- SH.2

> Personally I don't really like it, but…on the other hand, from a teaching perspective there's aspects where it's easier to teach I think……Even if you go on to *bunkei* 'I like this bit of mathematics' or something, there's those kids, aren't there? Or 'even though I'm going on to *rikei* I like this bit of *bunkei*'. So for those kids, taking their opportunity to do that is…not good I think. - NA1

M2.2 mused that her school's attached, elite, all-girls high school did not separate by B/R and sent a high proportion of girls on to *rikei* at university. She also mentioned a top private girls' school, which, on later inspection of the website, also did not use a standard B/R tracking system and whose alumni went on to *rikei* in large numbers.

Others valued the B/R system's ability to allow students to pursue their talents and not be weighed down by subject they did not like or were not good at. This was something that some of the teachers were grateful for in their own experience, having disliked, or describing themselves as having been bad at, *bunkei*.

> Well, I think it's fine. You don't separate them until high school first year and from second year you do……a lot of kids who are not good at maths, and even if they don't do maths they can do English or Civics or things like that. Forcing them to do maths…it's ok that not everyone is *rikei*. - BN3

> I think it's good if you're like I was, and you're clear on what you want to study. Being able to pick *rikei*. You can study more of your favourite subjects. But, I think it's probably pretty tough if you're a kid who's unclear on what you want. Like 'what should I do?' - T.1

Considering the importance of perceptions of inevitability to the problematisation process in Chapter 6, something that stood out was teachers describing the B/R system as being unavoidable in the context of the current school system. This is understandable considering the connection between B/R and university entrance exams elucidated in this chapter. Here, we see

the familiar idea of inevitability; that, however they feel about the system, it is too ingrained to change.

> I don't think [the B/R system] would change unless the university entrance system changes. Unless you changed all that, you couldn't change B/R. When you become a high school student, you generally understand, fundamentally, what you want to do so…in terms of what university you want to go to and what you want to study. So, I think it's better if you do separate it early into B/R. - X4.2

> Entrance exams wise, Japan has become like 'it's best for *rikei* children to just take this subject' 'it's best for *bunkei* children to just take that subject' so…because of that, well, splitting them into B/R, to an extent, in high school can't be helped, I think. - NA1

Teachers were roughly split between whether they agreed with the system or not. Neither group gave any impression that they felt students did not make their own choices between the two tracks, and we have also seen teachers in both camps describe both the skewed gender ratios in B/R and the constraints pupils -particularly girls - are under. Despite the inevitable nature of the deeply embedded B/R system, the gendered polarisation between the tracks, and the fact that teachers see strategy as the key element of the sorting between them, teachers still conceptualise it primarily as a choice. We can gain some new perspective on this conceptualising of choice if we compare teachers' views of the B/R system to their opinions on single sex tracking and informal single sex classrooms.

7.5.2 (Formally) Single-Sex

First, most had never considered these systems in much detail as single-sex education is relatively rare in Japan, compared to coed. Secondly, there was little enthusiastic agreement with the concept and many teachers were immediately against the idea.

> I don't think it's *bad* but...It's not like there aren't any girls who have a masculine thought process, or boys who have a girly feminine thought process.

> So, if you think about it from that perspective then it's best not to separate them. - M1.3

> I don't think I'd want to proactively do [single sex]…also society, work etc…men and women work together. There's femininity and there's masculinity, I think but…boys and girls can bring out the best in each other. - BH.Y

> Whether it's effective or…? I wonder. Well, for me, having lots of ways of thinking is a good thing, I think. Like, of course, I think boys might have their own ways of solving things, well, actually I don't know if that's true exactly? 'Because you're a boy, you think in this way' I don't really think there's that... But, either way, mixing lots of different ways of thinking together is better, it's better not to split them, it's better to mix them I think. - T.2

A few were neutral 'if it worked, then maybe…', and some were more positive saying they could see the utility in it.

> Yes, if you want to make them good mathematically then separate is better…but…together has benefits too Mutually different thinking, so boys' thinking style and girls' thinking style are each different, [they're] able to see both so boys will see how girls think, and girls will see how boys think and that's a good stimulus……Teaching separately, splitting boys and girls…um…will make them better at maths, they'll get better I think. - TO2.1

> That is also…interesting I think. I think that. I'm interested in [single-sex]. So, of course, like, there are girls' and boys' schools, so if there's a difference in mindset then I think it's of course better to separate them. - Z14.3

The potential social costs it would levy was a regular theme, with teachers pointing out that the real world is not segregated by sex, and men and women will be working together in the future. Interestingly, teachers who taught in single-sex schools (or schools with a single sex heritage) did not seem to be more positive about single-sex education than those teaching coed classrooms. A few teachers were completely unsure or had no opinion.

Teachers had a lot more to say, both positive and negative, about ability streaming compared to formally single-sex education. In the literature review, we saw that differentiating children by

performance and ability in this way had been a deeply unpopular concept for a long time in Japanese educational circles. However, more interviewees were in favour of it than not, and even those opposed overall often said they could see the benefits – this was true both of teachers whose classes were split by ability (mostly the public schools) and those whose were not (the elite national schools). The educational norms (and taboos) have clearly shifted in this case, something that we will bear in mind during Chapter 8. Here, on balance, we can say that the same cannot be said about single-sex schooling.

7.5.3 (Informally) Single-Sex

Overall, most teachers were against formal single-sex education; but when asked indirectly about single-sex education the responses were very different. Teachers were asked to consider a scenario where, by chance, their class was either all-boys or all-girls. Would they do anything differently?

We have seen that teachers view girls and boys very differently, so it is unsurprising that almost everyone said they would. Sometimes this was fairly minimal, such as Z14.1 saying that he would be more careful with his language in an all-girls class (an opinion shared by many, mostly male, teachers). But oftentimes teachers said that they would change their approach to setting questions, the content of their classes, the speed of instruction, or tailor classes to try and capitalise on girls' unique qualities.

Teachers of both sexes agreed that they would shift their content to be more interesting to boys, introducing challenges and harder questions if their class were all male. An all-female classroom would warrant taking things slower and with more revision and step-by-step teaching.

> There's things where you won't know unless you tried it but…perhaps for the boys I would give them slightly – *slightly* right, just slightly – harder questions. With girls I'd be more likely to pitch it at a level where they can safely solve [questions] and at the end put in a few hurdles. With boys I'd put slightly harder problems in from the start, make them think about it, then give them a problem they can do to check it, boys are more…getting their teeth into a problem I think. - M2.2

> Yes I would. More carefully I think. Carefully, neatly, one thing at a time, in detail…I'd do it like that.
>
> [Interviewer: and if it was boys?]
>
> Yes. Stricter. 'Think about it on your own!' [*both laugh*] yeah, stricter. With girls you have to look at *everything*, but yeah, if you do that then they can really…give you answers…I think – TO2.1

> Amongst girls, comparatively more than average, there are girls who aren't good at it and don't have confidence…especially girls in the lower end, that's very striking. Giving them confidence…like I said earlier…giving lots of easier tests and building it from there. Small steps are a good idea. Comparatively, with boys, giving them suddenly harder questions 'I couldn't do it, but I'm going to try again' there's that kind of feeling. But with girls you don't want them to fail, so you slowly build them up. That feels like a better fit - SJP

Most of the time teachers were either neutral or positive towards the idea of an all-girl class, some cited that they were easier to teach because they were well behaved or because they had better concentration ability. However, a couple of female teachers expressed distaste at the idea of a female-only class.

> I think it would be boring to just teach girls. I have a friend who teaches chemistry and that person teaches single-sex classes. And they said "girls are boring" "boy's thinking is interesting". I'm teaching boys and girls together at the moment, and the boys do say some interesting things. In that respect I think having boys is important…I think there's a possibility 'that just girls' will get stagnant. But like I said before, there are girls who aren't like that, so you could have to rely on those [different] kids. - M1.2

One teacher was upfront about the fact that she found girls' style of learning a bit irritating. The school had recently changed from being all boys to a mixed school, and the culture had shifted with it. Girls had been described as having more complex (read: difficult) social relations by a few other teachers, such as X4.2, and TO2.1 made it clear she did not like this. Likewise, she viewed girls as needier due to their asking for lots of help.

> When there's a problem and they have trouble with etc. Boys will think about it on their own, and do it on their own…….Yeah, with the girls there's a lot of ones that are…spoilt? Like the girls who you saw waiting for me, they wanted to ask me something about maths. More girls come to me asking questions.
>
> [*later* Interviewer: has the school culture changed?]
>
> It has. Completely. It's tough.
>
> [Interviewer: tough?]
>
> Yes, girls are tough. Thinking about a lot of things, like human relations etc
>
> [Interviewer: I went to an all-girls school [*laughing*]]
>
> Wow! All girls school would definitely be awful! –TO2.1

The hands-on, step-by-step, careful approach that, many teachers felt that girls preferred seems (perhaps unsurprisingly) to be less appealing to teachers; the fun of solving mathematics questions (particularly interesting or challenging ones) had been a major reason why they liked mathematics and chose to specialise in the subject. A much milder version of this, expressed by a mix of both male and female teachers, is that they related with boys better.

> There's a lot of sharp kids, but I think more of them are boys. I've studied maths at middle, high and university level and…even though middle school maths is interesting… out of the however many people I've seen until now that that I've been able to have conversations with like 'this part is interesting when you dig down further', they've mostly been boys. The people I've been able to discuss things like that with, there's been more boys. - X4.1

We have already seen a version of this when teachers struggled to understand what might connect with female students but knew ways to spark boys' interest.

So, although teachers were not supportive of single-sex education in a formal sense, almost every interviewee said they would change their approach if it was an incidentally single-sex classroom. Likewise, we have seen that there is widespread acceptance of B/R system (although not everyone is thrilled) even though its gender ratio is so highly skewed that it almost operates as a single-sex system. In the latter two scenarios, the gender ratios are theoretically just 'how things are' rather than officially constrained as part of a governmental or school level policy.

Once again, we are back to the issue of choice. If the B/R ratios are perceived as being the result of girls' *choices*, however constrained, this will be a barrier to teachers' problematising the gender gaps.

7.6 A Matter of Perspective

The B/R system seems to lurk in the shadows of many teachers' answers during their interviews, even if unspoken (or perhaps not consciously being considered at all). This was the case even with middle school teachers, even some teachers with no experience of teaching B/R classes at all. This too suggests how pervasive and normalised the system and its effects are.

In Chapter 6, teachers spoke about the impact of entrance exams during middle school. Boys would suddenly start working as they drew near and overtake the girls who had been steadily working hard the whole time. But is it possible that teachers are picking up on the shadow cast by the B/R system, extending far earlier than any official separation? When boys 'wake up' and get motivated, maybe the girls are too – just not for mathematics. The B/R system is an integral part of the education system in Japan. None of the teachers interviewed for this thesis will be unaware of it and will almost certainly have been through it themselves. The fact that we have seen so many teachers describe 'entrance-exam induced differences', 'textbook vs applied', girls' being only motivated for tests etc, yet relatively few teachers brought up the B/R system by name, suggests the connection was not made. The system may be so embedded and normalised that it can escape conscious examination for many teachers.

We saw in Chapter 6 that SB1, a younger teacher in a combined school, described the gap widening during the second year of high school. His 'Good Girls Don't Get Ahead'-style explanation focused on content difficulty; specifically, that the 'entrance exam focused' questions at this stage had gone beyond the textbook, straightforward questions that girls were good at. However, he never mentioned the B/R system and did not speculate that there might be incentive differences involved (i.e. that girls might have their own, different priorities at this

point). Checking the school's website, the second year is indeed when classes are split into B/R, and is likely another reason for what SB1 was seeing – even if he had perhaps not consciously considered it, or it was so normalised that it did not cross his mind to mention it to me. It was not until after an interview that lasted over an hour, that he mentioned B/R in any way, musing that the lack of *rikei* role models may be putting off girls from doing *rikei* subjects at university – there was no mention of what this might be doing to girls' motivations in his own classroom, however.

At first, it looked as if there was a pattern emerging about which teachers might be more likely to have a B/R perspective; perhaps they were the older teachers with more experience, or maybe they were the ones teaching at the high school level where B/R is split. However, this will need more data to confirm. We can say that the teachers with a purely, or almost exclusively, B/R perspective (SH1, BH.Y, and KM1) to their gender gap explanations were older teachers from elite schools, but even here they were not all high school teachers.

If we look at teachers who held a mix of a 'B/R perspective' (where girls' agency is foregrounded) and 'Good Girls Don't Get Ahead'(GGDGA) perspectives, we can see that the stage in the education system at which a teacher was teaching and, particularly, whether they were guaranteed to have taught B/R as a current high school teacher, did not seem to be the determining factor either. SH1 taught in an elite high school, but his interpretations were mostly in line with what we see in Chapter 6; people like T1 and Z14.2 taught in middle schools and were predominantly B/R in mindset.

There were also teachers who seemed to be close to noticing the B/R impact consciously. Their descriptions of their classrooms paint a perfect example of seeing the shadow of the system; these teachers were actually (mostly – SB1 excepted) working in middle schools. One of the more interesting experiences was watching the dialogue between X4.1 and X4.2. These two middle school teachers bounced off each other during the interview, starting from a perspective that there were no gender differences in mathematics, and ending up completely changing their minds – their explanations an even blend between the 'Good Girls Don't Get Ahead' and the B/R

perspectives by the end. One person would make a statement, and the other might jump in to challenge or add to their perspective, and the response would be along the lines of 'oh, yeah actually that is right'. It certainly suggests that bringing teachers together to discuss their perspectives might produce interesting results regarding the recognition and problematisation of the gender gaps.

In light of what we now know, teachers with the (predominant) mindset detailed in Chapter 6 (Good Girls Don't Get Ahead) might be overlooking girls' agency and overvaluing either explanations that rely on inherent, often biological, differences, or explanations that simply frame girls as taking a misguided approach and failing despite their best efforts. Likewise, some of the teachers favouring the B/R style 'choice' argument may be missing the strength of the elements of confidence, interest, and skill differences that factor into pupils' decisions. This could be because by the time they see their pupils dividing themselves into B/R it is already largely settled in these areas – it is too late and the perception of agency now overrides both the constraints and any concerns that it does not have to be that way.

It is possible that the ubiquity of the B/R system and its impact warps the lenses that teachers look through, even if they are not consciously aware of it. Teachers are looking at very similar 'putative conditions' but are interpreting them in different ways – even with similar reasoning. The 'change over time' condition was a common thread amongst almost all teachers interviewed. Yet in Chapter 6, where we concentrated on teachers' answers from a combination of Themes 1 (personality) and 3 (ability), we saw a very different framing compared to the mindset expressed in this chapter, which encompasses ideas of interest (2) and choice (4). In the former, we saw one explanation was 'entrance exams'; in the latter we see the same, but the incentive structure now has a name and a different set of implications behind them. In one, girls' agency is largely absent in teachers' perceptions of them, and in the other, it explains everything.

The reality is likely to be somewhere in the middle, and this is supported by the fact that there is no absolute separation between these 1/3 vs 2/4 themes. Individual teachers leaned

(usually heavily) to one side, but their explanations and views drew upon elements of both groups. Although the differences (the putative conditions) teachers reported were largely, and strikingly, similar, the pressures and environment teachers operate in, as well as individual factors such as experience and gender, lead to them having different perspectives. Whichever path teachers' perceptions took (the 'choice' version or the GGDGA version) both seem to lead equally towards the same place: non-recognition and non-problematisation of the gender gaps in mathematics.

7.7 Conclusion

In this chapter, we have explored an alternative explanation to that posed by the GGDGA line of thinking from Chapter 6. The cornerstone of this is teachers' perceptions of girls' agency. By applying the framework we developed in the last chapter, we can see how the B/R system affects teachers' recognition and problematisation of disparities between boys and girls.

Lenses and Perspectives

A key consideration from Chapter 6 is that the lenses teachers used to regard their classrooms would largely determine whether they noticed any gender achievement gaps. Here, we saw how the way the B/R system is physically set out makes it harder to make straight comparisons and 'see' gender disparities. The gender gap also hides in plain sight: although the tracks are so highly gendered, and the sex ratio so skewed, that they are almost sex-segregated, this does not trigger any alarm. This is because this system is ostensibly about choice – children sorting themselves into the two tracks based on whether they choose to continue with a group of subjects or not. The lens that teachers automatically reach for is therefore 'choice', not gender. Teachers' acceptance of single-sex classrooms if they are B/R (and therefore sorted by choice), contrasts with their distaste for official sex segregation – the critical difference between the two is teachers' perceptions of girls' agency.

Regardless of the exact motivations they ascribe for girls picking *bunkei* over *rikei*, teachers' perception of girls' agency in this system seems to make it harder to see gender, and also to problematise the gap – it presents a complete contrast to the kinds of views examined in Chapter 6 where agency seemed totally absent from the equation.

Credentialism (Part 2)

Even if teachers did view this with a gendered perspective and notice achievement disparities occurring (apparently even before an official separation takes place), it still leaves teachers with an understandable reason not to problematise the situation. Girls making a (theoretically) unimpeded, even rational, choice is not easy to class as a 'problem'. Do teachers have the right to interfere with a choice like that? And, considering how integral the system is to university entrance, and how teachers recognise the implications of the choice on future life course, how would teachers go about changing something so deeply embedded in the education system?

In Chapter 6, we advanced the idea that many teachers may be operating under a kind of credentialism of their own – that, as long as girls did well enough in class and progress tests, it was not problematic if they were struggling with applied and non-textbook mathematics. Here, teachers seem to be reacting to the perceived credentialism of girls themselves: female students choose *bunkei* and, when they do, their effort in mathematics will inevitably drop off. This changes the tone of the explanation entirely. Now it is not simply poor, continuously hard-working girls, anxious to get things right, inevitably being outshined at the last minute by talented boys coming into their stride. Now, girls become strategists who focus on their target and put their considerable effort and organisational abilities towards enabling them to do what they want to do later.

Under this interpretation, the 'textbook mathematics' vs 'applied mathematics' split of the last chapter could instead be thought of as 'tested' vs 'untested' mathematics. Instead of girls being simply less able to do complex mathematics, they are in fact, uninterested in acquiring the

skills which would allow them to do it. They are uninterested in expending the effort necessary to do well in something like PISA because they perceive it will not gain them anything.

Inevitable

This too is where another core reason for non-recognition and non-problematisation we identified comes into play: a feeling that things are inevitable or just how they have to be. A teacher who mentioned that you would need to change the education system upstream (namely, how students are admitted to university) to be able to change the B/R system at school and therefore reduce the gender disparities between the tracks – only did so in the context of explaining how difficult that would be.

Many teachers placed careers and future life course at the top of the list for why they thought students chose between the B/R tracks. Teachers clearly have an appreciation of the restrictions placed upon that choice – particularly for girls, who some teachers see mixing a consideration of motherhood and marriage into their decision. In Chapter 6, we hypothesised that teachers pointing to ultimate causes of the gender gap occurring long before (or long after – in this case) school would impact their problematisation.

The B/R system, and its impact on perceptions of the gender gaps, provides a different angle to teachers' explanations of the achievement disparities; drawing upon aspects of the other two major themes of responses we identified earlier in this thesis: interest and choice.

For 'interest' (Theme 2) we can almost substitute 'investment' for the purposes of this chapter. We established in Chapter 6 that teachers see girls as disliking (and uninterested in) mathematics, and that this affects their performance. Here, we see teachers think that girls' dislike of mathematics does factor into their choice between the two tracks, but this choice is certainly not attributable to a simple subject preference. Instead, the 'interest' that matters is actually whether girls see mathematics as a worthwhile investment or not. When it comes to 'choice' (Theme 4), this encompasses anything short of official, top-down segregation by the

government (or school) with no input from students. We have seen that if a class is split by students opting between two tracks, then the perception of girls' choice and agency seems to supersede all other ways to look at the situation.

In the literature review discussing problematisation, we saw that injustice and a sense of unfairness is crucial for groups to problematise a situation. In the case of *kikokushijo,* it was the idea that these children would be barred from success through no fault of their own due to the reality of the education system. By contrast, in this case, the salient fact is that it is still perceived as enough of a choice that it is not felt as an injustice. This is despite teachers clearly demonstrating that the choice is something constrained by both students' perceptions of their own capabilities and elements of the outside world such as career opportunities and/or parental gendered expectations. This became even clearer when we saw teachers accept an incidentally single-sex scenario but are far less comfortable with officially sex-segregated education.

The perception of girls' agency is what matters. When a majority of girls pick the same way (*bunkei*), so often that the few who do not have their own nickname (*rikeijo*), it fails to raise eyebrows. This situation does not match up well to our modified (non)problematisation model; Perhaps you cannot problematise girls working hard, doing well (enough), and choosing to go into *bunkei* for career reasons. However, you *could* problematise the fact that previously enthusiastic, confident girls are getting quieter, withdrawing from the subject, and not choosing to continue with mathematics even though they are capable of doing so with some guidance.

In the next chapter, we take a closer look at what else might be supporting teachers in forming this view and investigate the wider context and what makes it difficult for teachers to discuss and problematise the gender gaps, should they ever choose to do so.

Chapter 8 – Genderblind? Or Taboo?

8.1 Introduction

Over the last two chapters we have seen that there are different ways teachers can interpret the same kinds of patterns of achievement and behavioural/attitudinal differences, and these ways can be equally effective at preventing recognition and problematisation. However, we have also seen that teachers have considerable latent knowledge of the gender gaps; the impression we are left with is that different people are holding different pieces of the puzzle depending on their own background and experiences. Here, we will discover the environment that teachers operate in and how this is preventing teachers from bringing these pieces together.

The environment in Japan, both political and social, does not seem conducive to the gender disparities being recognised – not in the way we have seen other problems taking off in the public sphere as per the literature review. There seems to be a wide-reaching squeamishness to addressing gender issues when it comes to education, and a lack of cooperation and communication between actors at different levels of society who have the power to do something about it: including teachers, the government, businesses, and pupils themselves.

In this chapter we will dig deeper into the institutionalised culture of silence and investigate what effect this has on the problematisation of the gender gaps. As part of this goal, we look at teachers' own opinions on why the gender gaps have not attracted attention in Japan; digging deeper into the culture of silence that surrounds the topic and the barriers that prevent discussion and cooperation between different groups of actors.

8.2 Teachers' Reactions to the Gender Gaps

In Chapter 5 we saw that teachers reacted differently to the question of gender gaps. Some teachers were frank from the very beginning that they saw differences between their male and female pupils. However, the initial reaction of the majority was to say that there were no achievement differences, only to give detailed descriptions mere minutes later. Whatever camp

teachers fell into, some were concerned about the gap while others were not, some were unsure whether it could or should be fixed, and so on. To make sense of these disparate reactions, it is necessary to understand why the topic had not come up before.

First, we should state that the researchers interviewed, as well as several teachers, felt that the biggest barrier to problematising (and therefore closing) the gender gap was the lack of awareness and information available to teachers.

> Yes, I think it's possible to change it, but it will take time. But, if you compare it to the situation of long ago, it's got so much better. In Japan, the consciousness of the issue has raised, it was much worse before. [Interviewer: training for teachers?] I think consciousness reform is important - you need to be conscious of the problem. We need people to be conscious of the problem. – GS.R

This will be the first major question we will tackle in this chapter: Why do teachers think the issue of the gender gaps in attitudes and achievement in mathematics has gone undiscussed?

For most of the teachers, these interviews were the first time they had discussed gender in relation to mathematics in any depth – many said it had not crossed their minds to do so. They themselves were very upfront about this, with more than a quarter of interviewees stating explicitly that they had never considered gender at all, and many more commenting that this was the first time they had thought about certain key topics of the interview, such as single-sex education or the numerical gender imbalance in the teaching profession. Two of the researchers agreed that this was also their experience when broaching gender as a topic with teachers.

> When I look at the class I think 'of course, the boys and girls are totally different' that's how I feel…when it comes to lessons I haven't really ever thought about being aware of the gender gap - X4.2

> Honestly, I've not really thought about gender seriously before so…what I'm thinking when we're talking…I'm curious now. Really - SJP

To jumpstart the discussion, teachers were asked their opinions regarding the OECD PISA test's findings showing Japan has an unusually large gender gap even while being a top performer overall in mathematics. In Chapter 5, we saw that, while most teachers had heard of the PISA

tests themselves, and many had an idea of how Japan fared in the international rankings, only one knew of the gender gap data. It was not, teachers were clear, that PISA is not of interest in Japan, but that it was only what it had to say about its standing internationally that attracted attention. Asked whether they had ever come across this gender gap data, the answer was almost invariably 'no'.

Although only one interviewee was aware of the details of the PISA gender gap, the majority were still unsurprised – curiously, this applied even to those few teachers who were emphatic that they saw no difference between boys and girls in their own classrooms. I had expected them to be surprised that there could be evidence to the contrary on a more aggregate level. Of the minority who were surprised, few were shocked.

> I knew that the OECD ranking was high, but that there was a big gender gap? I hadn't seen that data, but I did think 'ah, that would definitely be the case' – SH.2

> Girls are higher? [Interviewer: No, boys are] boys are higher? Yeah, that makes more sense – B2.3

> Is that right? My current class…the top five students are all girls. Maybe that's rare then, but at the moment the five boys just under them have started to say 'how can we beat the girls?'. [Interviewer: is it very surprising to you then?] Yeah well, boys are much higher than girls at age fifteen? Is that right? Yeah, I don't see it - TO2.2

This was one of the few times when school type seemed to impact the response. As we saw in previous chapters, the homogeneity of answers across socioeconomic, gender, and even teacher age brackets is one of the most surprising features of the findings. Teachers who were surprised by the data came - with only a single exception - from two schools: the lowest performing public middle school in an economically deprived area, and an elite, university-partnered, national school with a background emphasising girls' education. It is important to note that, although not all teachers at those schools were surprised, it is unlikely to be a coincidence that the 'surprised teachers' were in these two bands. In poorer (economically and performance-wise) schools, the

standard girls' strategy acted as protective behaviours[10]– preventing them from being the bottom of the class through sheer diligence and organisation. Meanwhile, boys' typical approaches which made them so successful in other schools actually seemed to disadvantage them here according to their teachers. Meanwhile, boys were disincentivised in the (historically) female-focused elite school, where they were not eligible for admission into the prestigious attached high school. Although completely opposite school environments, some teachers in those schools saw boys as relatively poorer performers compared to those in other, similar schools.

Regardless of whether a teacher was surprised or not, or whether they felt there were gender gaps in their own experience, a very common reaction to learning of the PISA findings was to then say 'actually, I knew that somehow' – a quarter of teachers correctly guessed the specifics of the statistic before it was discussed. Memorably, the sole female teacher at one of Japan's top national schools, KM1, immediately guessed the PISA results correctly before giving an explanation for why the gap existed that lined up perfectly with that of OECD. One teacher whose initial reaction had been that there were not achievement differences, went on to describe them, and was completely unsurprised by the idea there was an especially large gap in PISA data:

> I wonder…that there's such a large gender gap, I thought 'ah, yeah sure'. Wait, it's the boys who are higher, right? [Interviewer: Yes] Yeah, I can understand that. The PISA tests are totally different from our test questions, I can accept boys getting higher grades in that…instead, if girls were better able to do it then I'd think that was strange – X4.2

The fact that so many teachers' original position was that there is no achievement gap, makes it even more surprising that, upon hearing that girls did worse at mathematics than boys according to this famous and (usually) influential study, few teachers were surprised for long. As we have seen over the previous chapters, teachers were able to rationalise the things they saw in their own classrooms, and they were able to quickly do the same with the PISA gap too – even if their own experience had not been that the differences were as pronounced as the test shows.

[10] See Section 6.2.1.1

For almost a quarter of the interviewees, what was surprising was not that there was a gender grade gap, or that it was large, but that it was *especially* and *internationally* large. The suggestion that the large gender gap favouring boys was not necessarily a given – as it was not as large in other countries and was even reversed in some places – clearly left some teachers taken aback. One teacher, TO.1, who had been upfront that he saw many differences between his boys and girls in their approach and their outcomes, explained this conundrum in an uncharacteristically unconvincing manner. His thoughtful, carefully reasoned explanations detailed how girls work harder, but boys have been equipped since childhood to think more mathematically – meaning that at crunch time boys will outperform girls. Here, he hesitated before reasoning that the PISA gender gap was so large in Japan's case because it was harder content, and so the countries with small gaps must have performed worse overall. This was despite being shown statistics that there were countries with higher rankings, but smaller gender gaps, such as Singapore. He was a little stumped about what exactly was happening in PISA that would mean Japan had a wider-than-average gender gap, as this did not fit with his explanations.

We saw in the previous chapters that, despite all the barriers to recognition, teachers have a lot to say about gender differences in mathematics achievement and attitudes – including a wealth of suggestions about how the gaps could be tackled. Nevertheless, we will also see that they have neither been talking to each other about it, nor come across the topic anywhere else. Individuals are instead being left to puzzle this out on their own, and only if they are particularly inclined to do so. The question remaining is: why isn't this a topic of discussion?

8.2 Main Reasons for No Discussion According to Teachers

Teachers and researchers had various views as to why the gender gap had continued to fly under the radar. However, there were three clear theoretical frontrunners: one root cause, and two supporting conditions that facilitated it. The ideas we will explore can be summarised in this formula which comes from the data in this chapter:

Taboo/Genderblind x Obvious/Uninteresting = No discussion = No awareness/problematisation.

8.2.1 No Awareness or Discussion

Understandably, discussion about something is difficult if you are not aware of it. Teachers confirmed that there was little to no discussion of gender at all in their day-to-day lives, let alone specifics such as the impact on achievement. They had no mention of it during training (either initial teacher training, or subsequent lesson-study style conferences), and they were aware of no coverage of gender difference in mathematics in media. We tackle the latter part of the equation above here.

8.2.1.1 No Media Coverage or Government Communication

Two main sources from which teachers could reasonably expect information on gender differences affecting mathematics achievement are the Ministry of Education (MEXT) and the news media.

When it comes to a rallying point to provoke discussion on gender and mathematics, we might expect the PISA gender gap would attract some coverage. The mathematics gender gaps in PISA have been statistically significant in four of the five recent testing cycles: 2006, 2012, 2015, and 2018. These years are also when large gaps favouring boys are found, with Japan's gap also being considerably larger than the gender gaps of both the OECD as a whole, and those of other East Asian economies (NCES 2019). However, conspicuously absent, is any substantive discussion of mathematics gender gaps – whether in PISA or otherwise. Other studies such as the similar TIMSS tests, or the few papers by Japanese researchers on mathematics and gender, show clear disparities in girls' achievements in, and attitudes towards, mathematics. However, none of these come under scrutiny from MEXT. Scattered and descriptive, the government does not offer commentary on, or investigation into, the gender gaps in mathematics. There is little in the way

of synthesis of data, most of the reports do little more than provide a Japanese-language description of the PISA results. There is no independent investigation into gender differences in mathematics either. Reports also do not include any of the OECD's own analysis – such as their finding that girls' lower self-efficacy explains most of the PISA achievement gap – and it was not mentioned that Japan's gender gap was much larger than the international average[11]. Regardless of Japan's international PISA ranking, which subject that cycle focuses on[12], or the size of the gap (including its relative size to either OECD or East Asian economies' averages), MEXT is quiet on academic disparities between male and female students – at least in mathematics.

When gender does attract any (admittedly minimal) attention, it has been either for academic gaps where boys are disadvantaged such as the reading gap, or for non-academic issues like the wellbeing survey in 2015, particularly for bullying. The government proves that it does go through and follow up on PISA findings; it released its own report on bullying that year which included far more discussion of gender than any of its academic reporting. The mathematics gender gaps simply do not seem to be included in the education ministry's (selective) interest in gender. That being the case, it explains why practitioners – teachers on the ground, who are in a position to keep their eyes open and make a direct impact – are not getting any directives from the government to take gender seriously as a problem.

> I wonder…it doesn't get discussed. I don't know if it's ok that it's not discussed, but…and the [PISA] test results too…For us doing this work [teaching]…for us normal teachers it's not really an area of concern. There's research institutions and things higher up, and they'll study and discuss things 'taking x into account, let's teach this way!' there's that kind of thing…but I've not heard of anything about the difference between boys and girls – Z14.6

[11] (examples: NIER, 2009, 2010, 2013, (2008 2016 . For comparisons to coverage in other issues: (NIER 2015; NIER 2016b; NIER 2016a)

[12] Focus cycles through the three major subjects tested. In mathematics years, attitudinal statistics such as those on attitudes are collected and are given special attention by OECD analysts. This occurred in 2006 and 2012 – two of the years where Japan had particularly large gender gaps compared with other OECD countries.

> The awareness is weak. About the gender gap. I don't think people think about it. - X4.2

Even if the government is not covering the issue, for whatever reason, you might still expect the media to pick up on the story – PISA results have attracted a lot of column inches over the years, and this media attention has contributed to PISA's influence over education policy changes. However, the mathematics gender gaps fare no better in mainstream reporting in broadsheet newspapers or TV shows. Most articles are seemingly cribbed straight from the MEXT reports described above, with the same focus on international rankings. Gender, and the gender gap in mathematics specifically, is not referenced in general reporting of the PISA results. Half of the teacher interviewees brought up the fact that there is no coverage of this issue in mainstream media, and that they had never seen it discussed anywhere.

> There isn't anything at all…I get that feeling. That there isn't much of a trend of 'boy/girl'…With PISA there's 'How's our ranking?' 'what was our position?' that sort of thing ends up on TV, but boy/girl trends are really not…Most people don't know about it because it's not on the news…and then there's nothing coming from the government like 'we need to raise girls' scores' so… -Z14.4

With discussion missing from both government reporting and mainstream news coverage, it falls to independent journalists to plug the gap – as it turns out, mostly those writing for the opinion pages of business news websites, or guest pieces for companies who run after-school tutoring programs (Tanaka 2014; Kimura 2015; Nikkei.Style 2015; Watanabe 2015; Koyama 2018; Hosoda 2019). Although not numerous, these articles are detailed and thoughtful, throwing the bare-bones government reporting into sharp relief. They cover the 'whys' and not just the 'whats' of the data, connecting the PISA gender gap in mathematics with those found in other areas, and linking them to wider issues such as women's participation in STEM, and even to recent gender inequality scandals. The only thing obviously missing from these pieces was any mention of the gender gaps being unusually large in Japan, something that we saw might be a 'hook' for

attracting broader attention. These articles seem to have little impact, despite their strengths, particularly as several of them have subsequently been removed. Now you cannot even accidently stumble across them.

During our discussion, a couple of teachers took pains to say that if more were known about the gender gap then people would be interested and want to fix it – as we will see in a later section, that is not necessarily true:

> But like with the information we've been given, that's all we can judge with. I think if people knew about the gap being that large then there would be many people thinking like 'right, so what should we do about it' or 'why?' well, even if there weren't loads of people there wouldn't be none, there'd be quite a few. - X4.1

In our modified (non)problematisation model, media coverage and the dissemination of statistics (such as the PISA gap) are a large part of how an issue becomes picked up and problematised. This was the case for the teenage prostitution case (Kinsella 2012), and its absence here is telling.

8.2.1.2 No mentions during training, no discussions at work

Unsurprisingly, considering the lack of information coming through those major channels, gender and its potential impact on attitudes and grades gets no 'airtime' in formal teacher training, nor in more casual kinds of training either. This was true for the initial teacher training courses, and in the famous 'lesson study' continuous education groups that meet regularly to discuss and find solutions to problems. Two teachers did report that they occasionally saw data split by sex on PowerPoint slides, but that this was never commented on.

> We get together and discuss teaching methods, [what we] use in maths lessons, problems/questions set for children, textbooks etc.
>
> [Interviewer: ever discuss the gender gap problem?]
>
> No
>
> – LND

> About the gender gap? Not really, no. I don't think there's many people who are particularly conscious of the gender gap. Of course…we've talked about those kids who have very low scores, and there are girls among them too… - BH.Y

Interestingly, gender was a topic during teacher training in a very specific, and recent, sense: etiquette training. Two of these teachers (B1.3 and SB1) were young, recent graduates, and the third who mentioned it was an experienced male teacher who ran teacher training and wrote books on mathematics teaching for new teachers (SK3). This covered, as one teacher bluntly put it, "all the sexual harassment stuff, you know".

Y.R a professor specialising in teacher training, said she was completely unsurprised with these findings. According to her, as a consequence of preparing teachers to cope with the increasingly narrow focus on university entrance exam preparation, 'social justice' style training has been squeezed out of training courses in recent years. This adds weight to the idea that teachers may indeed be prioritising entrance exams – whether their own credentialism or the perceived credentialism of their pupils. Fellow researcher, KG.R, helps run a grassroots programme to promote STEM to girls. He agreed that there was nothing addressing gender specifically in any teacher training programs, and that the teachers he had come across had been surprised when he had mentioned it to them.

> There aren't really any with it specifically about [gender], no lectures or anything like that. On the teacher side, it's about making sure that the teachers' professors are conscious of it. I think it'll act as a stimulus for those people who have absolutely no awareness. Even brief words make a difference, I think. What I concentrate on is to talk to people, at school teachers conferences etc. But it's very early days.
>
> [Interviewer: there is no awareness then…it's not just me]
>
> That's right. There's a lot to be done – KG.R (Researcher)

> Teachers have generally never thought about these things……People are busy, and societally...rather than an education to eliminate gender bias it's 'how many people got into what university' – Y.R (Researcher)

So, the younger generation is starting to be introduced to sensitivity training and the majority of teachers participated in at least some form of ongoing training like lesson study groups. We can see, therefore, that there are clear opportunities for discussion of gender's academic impact, but that these opportunities are not being taken.

This was not only happening in formal, institutionalised, settings; teachers also reported that there is almost no casual discussion of gender within schools. This is regardless of school type, ranking, or even teacher gender – female teachers were no more likely to have discussed gender with colleagues. 75% of interviewees had never mentioned gender in any capacity to their fellow teachers, with the remainder saying that discussion had been limited to occasional general comments such as "the boys are doing well this year" or "girls don't seem to like the area questions". The sole exception was SB1, a young teacher at one of the top private schools in Tokyo, who said that the school was concerned enough about their own grades gap (and the lack of girls continuing in the STEM track after fifteen) to call a meeting to discuss what could be done. He confirmed that this discussion was entirely in-house and was never raised outside of the school (for example at the inter-school lesson study meetings). Perhaps most surprisingly, there was no discussion of these issues at the elite national schools attached to research universities. This was true even at one school which had links to a university with a heritage of being at the forefront of women's education; those teachers were no more likely to have thought about this issue than any other.

So, we can see that teachers are not getting information from the news or from their research groups. They are not discussing it in staff rooms, and it is not covered by teacher training – foundational or ongoing. Those who are not particularly interested in gender issues are not going to seek out the information themselves, and the likelihood of them stumbling upon think pieces by individual journalists is low. We have seen the barriers for teachers to notice the gender gaps themselves. Understandably, considering the dearth of information that might prompt them from outside, the gender gaps are not a topic of discussion: Japanese teachers do not discuss

gender differences (even though they report them to exist), the government seems to be almost deliberately ignoring disparities, and the media are generally following their lead. With no information coming 'top down' from the ministry or media, and no discussion coming up from grass roots either, the question still remains as to *why* this issue is not attracting attention in society more broadly. We have analysed what mechanisms seem to prevent teachers as individuals recognising and problematising the gaps, but we have not yet seen why they think this the case in their own words.

8.2.2 Uninteresting, Obvious, and Unimportant.

The other category of explanation is that, even when the facts known and recognised as being gender differences, it is still not considered worth thinking about – it is not considered a *problem* More than half of my interviewees suggested that gender gaps in attitude and achievement were overlooked due to public indifference.

Taboo/Genderblind x **Obvious/Uninteresting** = No discussion = No awareness/problematisation.

8.2.2.1 Gender Differences are Normal and 'Fine'

M1.3, a young female teacher at an elite national school, put it bluntly: "no, [the gender differences] are just a given. What teachers think is 'it's just common sense', that's what I think". Ideas like *Girls are worse at mathematics* (even if their grades might be better because they work harder), *dislike mathematics*, and *choose not to continue with the subject or work in related professions* are all just widely held opinions reflecting social norms. These gender gaps are considered 'obvious' or 'expected' and therefore would not be of interest to society.

> Um…maybe it's because that kind of thing is unspoken [/tacitly understood]? There's a lot of men who are good at maths. Women have a lot of *bunkei* [humanities] thought processes, they're good at Japanese…they like it. That kind of thing is – in reality – common sense. There's thinking that there's no need to research it beyond that – TO2.1

> Well, because it's not really a discussion, there's not really anything in newspapers... There's occasionally things about 'what compared to abroad' but there's nothing in the papers about the gender difference, so I don't think

> people really know about it. And as for why it isn't it in the news, it's because – in the end – it's just as expected, 'it's not news'. - M1.3

> Yeah, that's right. From the beginning, that a word like '*rikeijo* ' has come about in itself is like '*rikei* is men' isn't it? There's that sense. '*Rikei* women are rare/unusual' aren't they? So, in that way: males having higher grades it's 'oh, ok' and, well, you just accept that but... However, from a teaching perspective 'why has such a gap come about?' even if you ask what the cause is...I'm conflicted about that. – T.2

A substantial minority of interviewees advanced this explanation: that gender differences exist but are seen as, or actually are, unimportant. The above quotes get to the crux of the issue: Why would you be worried about something completely normal and expected?

Teachers are positing that the status quo, obvious to everyone in society (including the girls themselves), is considered 'fine'. Whether it is businesses looking for employees, schools, parents, and the girls – the idea is that these groups do not frame the gaps as an issue that needs changing. Even though school is often considered an environment isolated from societal gender roles (Okano and Tsuchiya 1999, p.78), everyone is still conscious of the compartmentalisation of work in the outside world. 'Yes there's a gap, but that's ok' was the view of a not insignificant minority of teachers in my sample, so it is not surprising that they might think this is true of society at large, and they are probably right. This would probably have frustrated, but not surprised, some of my other interviewees who wanted to see change:

> Even amongst teachers there's a longstanding feeling that there's a gap, and it's just one of those things. Definitely. And therefore they don't really…so for example with your regular tests – even if there's a difference in scores and you're seeing clearly that the girls are doing worse at maths – 'ah, girls and boys are just like that' is how they feel. If you don't have the feeling that 'it *shouldn't* be like that, we have to have [the scores] be the same' then it won't really be a topic for discussion – M1.3

We have also seen that, in a complementarian sense, some teachers themselves were unconcerned with the gender gaps because of a perception of balance between men and women in the real world.

> I mean if you want to *eliminate* the gender gap then that…might be important I think but women have an important role…they can do things that men can't. So that's men/women's…there's two…there's parts where you can get balance. So, I think forcing the elimination of that gap isn't really important – Z14.6

This was absolutely not a view only held by male teachers; as usual, there were no particular demographic traits in common. An experienced female teacher, T02.1, had been clear from the start that, in her view, there were huge gender differences between boys and girls in both attitudes and achievement throughout middle school. She attributed this to inborn differences between the sexes that leave boys and men with better mathematical thinking ability. She was matter of fact in stating that "there's balance, women and men are better at different things and that's fine", and that she herself as a mathematics teacher had a "man's way of thinking".

8.2.2.2 Gender is 'Boring'

A few teachers gave the least common, but simple, explanation: gender is just not considered an interesting topic in Japan by most people, so it would not attract any attention anyway. A clear demonstration was given when I caught up with an interviewee interviewed during my MPhil research a few years earlier:

> It's not something I worry about. Is there a big gender gap? Probably, is my thinking. I don't know about other teachers – I do think there *are* teachers who worry about them – but I don't think there's many who would look at something like those gaps found in TIMSS or PISA and places like that and be interested in them. Like the extent of the reaction would probably be just 'oh, I see' – B2.1

He had been politely uninterested in the topic the first time we had discussed it, and that had not changed when we next met. He had not known about the (then, fairly recently, published) new instalment of the PISA results during his second interview, either. A thoughtful man, he was clearly deeply invested in his students' success – he just was not concerned by gender and it was simply not an interesting variable for him. His young colleague, B2.3, was one of a few teachers

who asked after the UK and was bemused to hear that gender often comes up in education reporting, particularly with STEM subjects.

> Is it [gender gaps] regularly discussed in the UK? Huh…wow. I don't think people have an interest here. Like, rather than 'gender gaps', it's more 'gap with other countries' …so I think that's more… - B2.3

A lack of interest in gender is so normal that I had one teacher say he wanted to ask his class the same question I asked during the interview: why was there no discussion? He emailed me afterwards saying that his pupils, male and female alike, had been confused by the question and requested he ask me why gender was such an issue in the UK, in return.

8.2.2.3 In Combination: Not Gender, Not Unusual, and Not Interesting.

BH.Y, the only teacher to have known about the PISA gender gap before the interview, explained how the reason behind the inattention was usually a combination of all positions:

> Well, this goes for me as well, really, I'm not too aware of gender either so I'm not sure I can look at this objectively! [laughs]. These days, I don't personally agree with this, but society as a whole has a fixed idea of 'boys can do maths, and it's ok if girls can't' so that kind of thing is one cause, I think. I think it's fairly strong that people aren't aware of gender – in a good way, I think. I think we need more research on how to best make use of boys' and girls' characteristics – BH.Y

Some researchers lamented that a lack of interest in gender specifically was likely to be (at least partly) behind why only international rankings attracted much attention. A quarter of the teachers assumed, correctly as it turns out, that the international competition aspect of tests like PISA was the only part that would attract attention in the government or media. Teachers had noticed that the coverage was only focused on these international rankings.

> There isn't anything at all…I get that feeling. That there isn't much of a trend of 'boy girl' … 'How was our ranking?' 'What was our position?' that sort of thing ends up on TV, but boy/girl tends are really not…
>
> [Interviewer: why?]
>
> Why, I wonder. Rather than boy/girl it's 'how are we doing as a whole?' that's what people think about. In Japan there really isn't much of a trend of

> boys/girl……Like I don't think most people know about it because it's not on the news. And then we there's nothing coming from the government like 'we need to raise girls scores' so… - Z14.4

Teachers were clear that Japanese society does not see the mathematics gender gap as an actual problem. People are not interested in something that, frankly, was exactly what they would be expecting anyway. Researcher Y.R felt that the appetite for international comparison – but not for domestic facts like the gender gap - was a holdover of Japan's famous 'catch-up' mentality, whereby educational policy decisions were made in large part to bring Japan closer to a (perceived) Western standard. "If it's not just about catching up, then it's all about international ranking – that's what's left over", she lamented.

It is understandable that international rankings are the aspect of tests like PISA which attract the most attention; not just in Japan but in many participating countries, the format invites comparisons and perhaps a sense of competitiveness. The idea that the gender gaps are uninteresting because they are seen as a solely domestic concern (therefore missing the interesting international comparative aspect) is undermined somewhat by the fact that you could compare gender gaps too. This is something that other countries have done with their gender gaps in mathematics, and the comparative data is even prominently placed in the OECD's own discussion papers and webpages, complete with visualisations including graphs (OECD 2015). The gender gaps in Japan would benefit from being given this treatment; the achievement disparity is large, but it is only really possible to grasp how large through comparisons with other countries.

This effect is visible in the reactions of a quarter of interviewees; teachers who had been unconcerned about the PISA gender gap often became concerned upon hearing that Japan had a particularly large gap in comparison to other OECD countries including the other East Asian economies. This is exemplified by one, experienced, teacher. She was one of those who guessed the PISA test results and gave an eloquent explanation as to why it was the case. However, she

had not known PISA's gap was unusually large; something that was clearly a shock and thew her off a little.

> The girls are lower, right? Of course. Those kinds of questions [PISA test] girls would be lower, I'd think. Those are completely different from school study…in terms of technical ability [girls] are good, but when it comes to thinking ability then……[*Continues with her explanation* Interviewer: the PISA gap is double the average] Oh…I'm surprised. I guess it makes sense with those kinds of questions…that's surprising…I don't think that's really the case in normal schools… - T.1

With an international comparison – just like with the overall rankings – something that was considered normal, expected, and natural was suddenly transformed into something that is not necessarily inevitable. Indeed, we saw in previous chapters that many teachers felt that things could be done to minimise the gap, even if it would not be possible to 'fix' completely. It could be possible to leverage that aspect to draw more attention to the gender gaps – people would then be free to make up their own minds up about whether it is a concern or not.

We see that teachers may become concerned with the gender gap once they have the data, although the question remains over whether teachers like B2.1 who had (as mentioned earlier) remained uninterested, are in the minority or not. This was also the personal journey of one researcher, KG.R. For him, it was only after he had started working on the STEM outreach project aimed at girls that he started to notice gender differences.

> Well, for me, honestly, I hadn't ever been particularly aware of the gender gap. And when I was teaching in middle schools, there wasn't really…aiming for university and the subject you wanted for your exams was more…There are various choices that you make, is what I thought. And then with our middle school itself…I wasn't really aware of gender differences in kids' initiative and situation. It's only since starting this current work that I've come to get that awareness, to be really honest – KG.R (Researcher)

If this cluster of responses was the only one given, we would be left with an impression that the gender gaps – even if brought to national attention – still would not be of much interest. The assumption would be that the gender differences would be expected, considered 'fine', and

therefore go unnoticed and unproblematised. Indeed, Chapters 6 and 7 have shown how easy it is to ignore the gaps, and how difficult it can be to problematise them even if they are known. However, the reality, according to teachers, is more complicated. Another major branch of explanations is that teachers are not supposed to notice gender gaps, not just that they do not do so.

In previous chapters we have seen how easy it is for teachers to look at the same 'putative conditions' and explain them away – even if from different perspectives. In Chapter 6, we introduced the idea that the lenses teachers use can provide different rationalisations which can overwrite the gendered aspect for teachers.

8.2.3 Taboos and (Misplaced?) Genderblindness

Thus far in this thesis we have concentrated much more on how it is easy to overlook the gender gaps, but a complicating factor is that people could also be purposefully ignoring gender, and therefore any discrepancies in standards between boys and girls. In previous chapters, especially in section 6.3.2, it was mentioned that teachers are reluctant to (or outright discouraged from) using the lens of gender.

The gendered lens is not being used - on purpose. More than half of my interviewees suggested this was the case, and it was the dominant theory of the researchers. Gender, they said, is simply something you do not talk about. There were two well-defined versions of this response, reflecting two sides of the same coin: 'genderblind', and 'taboo'. We concentrate on the first part of our formula now.

Taboo/Genderblind x Obvious/Uninteresting = No discussion = No awareness/problematisation.

8.2.3.1 Genderblind

The genderblind approach is a progression of the values we encountered in previous chapters: the desire to treat kids equally, and the desire to treat kids as individuals. Both goals

involve not considering demographic characteristics like gender, race, or class. Some teachers even made concerted efforts to avoid explicitly bringing gender into the equation – even if it is obvious that it is what they are referring to[13]. Z14.3 and M2.2 explain that gender gaps have been purposefully deemphasised in favour of focusing on other aspects of children's performance. Many teachers explained that gender is not considered the right lens for looking at educational disparities.

> The important thing is to treat your students as individuals, regardless of gender, 'this kid has this kind of individuality, these kinds of special skills, so we'll do this or that…' so…there might be things that are different but…meet them before, don't be like 'you're a girl so you're like this' or 'you're a boy so you're like this' before you meet them – Z14.3

> To begin with, they're not looking at it from a 'man/woman' perspective. But it's not like they're not paying attention to kids. They're thinking about other factors and causes like 'they're good at it/not good at it', and motivation. It's not about dividing it into two 'boys' 'girls'. They're looking a bit more deeply. In terms of results 'this kind of kid, there's lots of girls' 'this kind of kid – there's lots of boys' there might be some of that kind of thinking, but dividing it by boys/girls I think it's like 'what's the point of that?' Looking at the kids as individuals, one by one… - M2.2

Several teachers' reactions to the idea of augmenting teacher training to include gender exhibit this kind of thinking. Although many teachers were positive, or at least neutral, towards the idea of introducing awareness-raising and training on gender differences, those who objected outright explained their objections in genderblind language. They were also concerned such training would bias young teachers before they had a chance to try teaching for themselves and make up their own minds. As if to show the complexity awaiting those who want to coordinate a response to the gender gaps, these teachers had also agreed that there were indeed many gender differences and that the gaps were a problem, yet still felt that training would be the wrong approach.

[13] See Section 6.3.2.2

> Fundamentally…more than thinking about it as a gender difference, in what way should you teach each student individually - I think that's important at the moment – B1.3

> I'm not sure. There's things that I think would have been better to know but I wouldn't have wanted to have preconceptions about it so…'it's like this' I think going off to your work with expectations like that wouldn't be helpful - KHW

A genderblind approach seems like the ideal: a pupil's sex and its potential impact on their attitudes or outcomes is deliberately put aside, with noble intentions, to focus on treating children equally and individually. It does seem to be behind much of teachers' reluctance in previous chapters to name gendered disparities as being gendered. According to many of my interviewees, however, this impulse was not always coming from a place of benevolence so much as fear. For those teachers, a goal of avoiding gender as a topic in the interests of fairness had just made it impossible to talk about disparities that 'everyone knows about'. Several teachers (and three of the researchers) even used the word "taboo" to describe the situation around discussing gender differences.

8.2.3.2 Taboo

"Is there a taboo about it? Yes, yes for sure. That's probably obvious", was the immediate response of SJP, a teacher at a public school in middle-class area. He was far from alone, with many teachers making references to people purposefully "turning a blind eye", "averting their eyes", and "closing their eyes to" this socially unacceptable topic.

> Discussing things like differences depending on gender is a bit taboo really, isn't it? How do I put it? Even though everyone vaguely feels that there's some differences between men/women it's like everyone thinks 'it's better not to say it' that's what I think [Interviewer: Taboo is an interesting word to use there?] Just a little taboo. It's not a big taboo. [Interviewer: Not forbidden, just best not to mention it?] Yes! Yes, exactly – SH.2

The majority of those who felt that the gender gaps were being deliberately ignored, believed it was down to this kind of 'taboo', rather than the more admirable genderblind approach. They

felt that many people find it too uncomfortable to even raise the topic, even if the gender differences were the kind of 'obvious' we covered in section 8.2.2. Several teachers gave the distinct impression that being able to talk frankly about what they saw as gender differences in their classrooms was a relief. Some of the teachers who began their interview maintaining that they saw no differences, ended up giving detailed descriptions of things they had noticed in a cathartic rush. One teacher, who provides the emphatic opening quote of this section, followed this pattern. He explained that he had felt the tug of the taboo as we spoke:

> So even though there's results that have come out saying that…I just feel like no one has really been interested [laughs] But perhaps…as a feeling Japanese people have is…that we're not allowed to talk about gender boys/girls. Even talking to you today I've felt some 'resistance' to that…so I think that's got a lot to do with it - SJP

While interviewing one teacher, the school principal wandered in to join the interview. Both of these experienced, older teachers felt that, in recent years, the topic of gender had become verboten in every aspect. Several of the older interviewees brought up the fact that things had changed.

> SH.1: You'd ask the boys to carry the heavy stuff, now you're not allowed to do that kind of thing. That's happened with everything. 'They're a girl, so…', 'they're a boy, so…' That kind of speaking, at educational meetings too, isn't allowed any more. People *say* it's not allowed, [mimes telling off] 'boys and girls are the same!' that kind of thing has spread through
>
> Principal: Yeah. For us, back in the day, that was how it was but now everyone is trying not to notice the differences between boys and girls
>
> SH1: Things have changed a lot
>
> - SH.1

Practitioners on the ground feel like this is a topic that they are discouraged from talking about, and researchers believed this taboo was the number one reason that there had been no problematisation of the gender gaps from those with the power to do something to instigate change.

The researchers interviewed worked in fields such as teacher training, mathematics education or performance (including those who had published during the brief heyday of literature on gender in the 1980s and 1990s) and government researchers. Three are female, and two of them spoke of hostility to their work. SM.R, a mathematics education researcher who analysed gender in textbooks, as well as the results of the international TIMSS studies in the 1990s, says she was admonished to 'let sleeping dogs lie' and subjected to pointed questions like "even if you did find something, what are you going to do about it?". She was particularly pessimistic about the effect of the taboo and strongly advocated 'sneaking' gender into teacher training to avoid switching people off instantly – judging from the mixed responses to gender specific training from my interviewees, she is right to be cautious.

GS.R a government researcher, was clearly exasperated by societal sexism. She even mentioned specific incidents such as the then recent gaffe by a Kagoshima politician who said that it was more useful for girls to learn flower names than trigonometry. She spoke of a climate within the government that strongly discouraged discussion of gender issues.

> [Interviewer: is the government worried about the gaps?]
>
> No, no. It's not a very big issue. Well, actually it's a bit difficult to say…discussions surrounding gender gaps… Um, we do know it's a topic…but it's not really considered a big deal…if anything, how should I put this, it's taboo territory. It's a big topic, but it's not an atmosphere where you can openly, everyone all together, clearly discuss the problem - GS.R (Researcher)

Teacher WS1 also notes this taboo climate. Like SH.1 and his boss, he agrees that things have changed. Information about gender disparities used to be easier to get hold of, explaining that he used to have test results listed with average scores of male and female students. Now this was not allowed.

> It's less 'not released' and more 'can't release'. It's taboo, it's not that it's forbidden, it's just not done – WS1

He also trains mathematics teachers at a top private university and felt the 'taboo' climate was suppressing discussion of the mathematics gaps in wider society. He hypothesised "girls were an afterthought in the distant past" and that, as part of compensating for that, it's now "become 'taboo' to even compare them…it's a huge swing [from] 'this was bad, so let's do the complete opposite'".

Most of the researchers (as well as a couple of teachers) also directly accuse the government of purposefully withholding information about the gender achievement gaps. KG.R is a former mathematics teacher, researcher, and director of an inter-university programme aiming to get more girls involved in STEM. He has therefore come face to face with the difficulties of promoting awareness of STEM gender gaps and the need to encourage girls into these areas. He believes that the reluctance to confront the gender gap issues is a hangover from the early twentieth century period – a deeply rooted feeling that women do not really go out into the world or study but should instead concentrate on family. Similar to the kind of environment of purposeful suppression of information (and any substantive discussion on it) that government researcher, GS.R, describes, KG.R paints a picture of semi-subterfuge in the government whereby they purposefully keep information on the gender gap hidden.

> I think they purposefully don't release the [gender] data. They have it internally, and there would be discussion but it would all be verbal, nothing official…not heard of anyone actually discussing it though… -KG.R (Researcher)

> But the results themselves don't come out as boys/girls do they? Right? [Interviewer: Yes] That's Japan for you. They don't have it. No, no there isn't any data available for boys and girls – yeah...It's easy to do [split data by] boys/girls but they don't give those over. Try asking the ministry why that is [laughs].
>
> [Interviewer: they *must* have that data]
>
> They *do* have that data, they must. Worth asking why they don't, they have this data, but they don't publicly release it [laughs]. It would be useful to have that kind of thing 'this question the boys did better at, this question the girls did better at'. That would be interesting. It's not looked at from a boy/girl perspective - T.1

8.2.4 Section Summary

We have seen that there is little information on the gender gaps coming from an outside source, and opportunities for discussion available to practitioners such as the 'lesson study' groups are not taken advantage of. In an echo of the views expressed by teachers themselves in previous chapters, they feel that gendered expectations (and the reality of how society is structured) mean that attitude and performance differences between boys and girls are considered too 'normal', 'natural', or 'expected' to attract much anyway.

To complicate things further, however, we have seen evidence that merely mentioning gender, let alone expressing concern over its effect on pupil attitudes or performance, is strongly discouraged – even if it *is* common knowledge. Most of the researchers, and some of the teachers, even feel that the government is deliberately withholding information to ensure this. The effect, according to both groups, is that discussion on the kinds of trends that teachers reported in the previous chapter is stifled pre-emptively.

8.3 Cooperation Between Teachers and Government

So far, this chapter has looked at the non-recognition and non-problematisation issue from teachers' own perspectives. Therefore, we have seen peculiar situations such as the government ignoring the gender gaps, and therefore not communicating any data or sense of problematisation with the teachers who work with them. Something that teachers would not say about themselves, so thus far unaddressed in this chapter, is their own role in this. One of the barriers to problematisation (and recognition) seen in both previous chapters was teachers' own attitudes towards acting collectively to address the gender gap.

Firstly, there was some distrust – or at least a disregarding – of government and its potential role in fixing the gender gap. We saw in Chapter 6 that very few teachers felt that the Ministry of Education had any worthwhile role at all in fixing the gender gaps, apart from maybe to spread

awareness. More teachers explicitly stated that it was *not* the Ministry's responsibility to take concrete action.

> The ministry… they can say to 'do that ' , but reality is if it's not coming from teachers then I'm thinking it wouldn't really work - M1.3

> I think [it being the responsibility of] the 'government' or 'Ministry of Education' is wrong. Girls and boys have to be educated the same, so it's not like boys are given more strength - T.1

> If the government tried to do something itself then I think it would backfire and nothing would come of it. I have that feeling - M2.2

We have seen that several researchers and teachers think that the government is suppressing information on the gender gap deliberately. We have also seen teachers make a strong case for there being a culture of genderblind/taboo that means they should not be discussing gender and achievement at all. However true, this suspicion does not bode well for the open communication and cooperation that would be so necessary to deal with such a complicated issue as the gender achievement disparity and its causes.

However, there is another element to teachers' objection to the idea that government should play a part: they do not actually seem supportive of an institutionalised or collective response to the gender gaps. This is something that came up throughout this thesis. Overall, teachers did not like the idea of government making policy changes to address the gaps, and they generally did not like the idea of schools implementing school-wide policy either – the reasons were that it would be discriminatory. Instead, teachers thought it was their own responsibility to do something about it.

> I feel like the country doing something would be the wrong approach. [Interviewer: at school?] Actually, as a school, teaching 'let's shrink the gender gap' I wouldn't express that. Actually, I think it would be the opposite and it would become gender discrimination – I get that feeling. If you really want to

> shrink the gap then I think individual teachers altering their lessons might be better - Z14.5

Instead, we saw that they provided individual level suggestions, but only when specifically asked in relation to specific problems they identified as feeding into the gender gap (such as interest and confidence) and not the whole gender gap. These suggestions were for individual teachers to work through, with individual students, to provide a solution for students' individual weaknesses in mathematics. It was not suggested that there should be a large-scale solution, involving an organised and official response, to target a lot of students at once. This echoes how, in previous chapters, the inevitability of the situation was a major barrier to both recognition and problematisation, regardless of whether the emphasis was placed on childhood socialisation, biology, or the deeply embedded systems like the B/R tracks.

This individualised response is exactly what we might expect to see from a teaching culture that shifted to include values from the *yutori* reforms. Indeed, we have also seen in this chapter that many have an aversion to using the 'gender lens' themselves – saying that they do not see their pupils as 'boys and girls', but as individuals and that teaching should be genderblind etc.

Even though many had pointed to society at large as both the cause and the party responsible for fixing it – teachers did not often mention the government as having a role in finding ways to fix either the hostile work environment, nor in trying to influence societal messages communicated to children and their parents. Even though teachers recognised the deeply embedded nature of the B/R system, and its use for university entrance exams, and even saw these as factors feeding into the gender disparities, universities were not on the hook for helping change the situation either – even though they have a huge amount of control over what they require for entry and therefore what they incentivise during school.

Their avoidance of finding a solution collectively (at least in this case with gender and achievement) meant a surprising dearth of suggestions that inter-school conferences, lesson study groups, etc., could be a way for them to pool their knowledge and resources. This is the

case even though most teachers did participate in such knowledge sharing initiatives , and one teachers' school had even set up their own (intra-school) committee to address its own gender gap. However, as we have seen in this chapter, clearly nobody has – even at the teacher training level – decided to incorporate discussion of gender into any continuing education for teachers. This is especially surprising considering the literature we have seen on how powerful grass-roots, lesson study avenues are for teachers who want to affect change and find solutions (Fernandez and Yoshida 2004; Isoda et al. 2007; Takahashi 2017).

Not only does squeamishness at institutionalised responses help to explain why none have been offered by teachers, the flipside shows us a major reason for how the gender gap issue has stayed unproblematised. If it is not an official, institutionalised form of discrimination that can be pointed to, then it is not considered unfair. This was clearly demonstrated when we compared teachers' reactions to official single sex tracking and informal single sex classrooms (including B/R) in Chapter 7. There, this dislike of institutionalised responses was also seen in teachers' general distaste for the idea of formal single-sex education, but their acceptance of incidentally single-sex environments – including de-facto sex segregated B/R classes. If it stops short of being official policy then it can remain unproblematised by teachers.

8.4 Conclusion

Let us revisit the formula from the beginning of the chapter:

Taboo/Genderblind x Obvious/Uninteresting = No discussion = No awareness/Problematisation.

From this we can see that an immediate problem facing the problematisation process is that there is no discussion. This is largely because the information which would allow that to happen is not being disseminated by government, media, or even teachers themselves. Teachers also point out these circumstances are supported by a complex, often seemingly contradictory, interaction between people not seeing the disparities as a problem (obvious/uninteresting), and those who do not want them to look closer (taboo/genderblind). Therefore, individual teachers are being left

to recognise and problematise the gender gaps by themselves – something we have demonstrated is difficult to do.

We also see that – at least concerning the gender gap issue – there is little cooperation and communication between two groups of actors who, arguably, have the most concrete power to spark discussion and find solutions: teachers and the government. Teachers are distrustful of the idea that the government could interfere with gender differences in mathematics and seem to dislike the idea of institutionalised or collective responses, favouring individualised ones instead. We have also seen that if the discrimination is unofficial, it is likely to go unproblematised by many teachers.

Lack of Information

There is little information about gender gaps in mathematics available from either the government or the media. The government is either uninterested in disseminating or, according to teachers and researchers, purposefully holding back information about the gender gaps in achievement and attitudes in Japan. Mainstream reporting is descriptive and brief, and even though there are some independent pieces that have more detailed discussion (including the OECD analysis of PISA data) they are few and far between – if they are even still available at all.

Meanwhile, practitioner generated discussion is also demonstrably absent. Japan has a famous track record of grass-roots, practitioner-generated teacher training such as the 'lesson study' groups. However, every teacher confirmed that gender had never featured in their training, either initial teacher training or in any subsequent continuing education settings. They also reported that there was little discussion of gender differences, even casually, with colleagues. None of the researchers were surprised to hear this, with one even commenting that she would have been shocked if they had.

That (almost) no interviewees were aware of the PISA gender gap had originally come as a surprise, considering how influential the tests have been in the past on education policy and how much coverage they generate in Japan (Takayama 2008; Knipprath 2010). It is clear, at least in

relation to those 'on the ground', that PISA's reach and power has been vastly oversold. We saw in the literature review how important a main advocate/activist group is in the push for an issue to become problematised. It will not be possible to rely on the OECD to fill that role.

With nothing coming from the 'top' (media or government), nothing generated from the 'bottom' (discussion and grassroots efforts from teachers), and nothing getting through from the outside (PISA, TIMSS), it is no surprise that there is no widespread problematisation of gender gaps in mathematics considering how crucial recognition of the topic is to problematisation.

However, according to teachers, it is also not as simple as making the raw facts and statistics available either.

Taboo and Genderblind

For the sake of discussion during this results chapter, we separated the two main branches of explanations artificially. However, the reality is that these separate threads are tightly interwoven. There was a large amount of overlap between those who felt that the gaps were ignored because they were uninteresting, and those who felt that people were deliberately ignoring them. This is a huge puzzle surrounding the lack of problematisation of gender disparities in mathematics. If girls are expected to have an aversion to mathematics, to perform worse in tests that move beyond regurgitating facts, and that boys are the one with real talent, if it is 'just the way things are', and therefore unsurprising, unnewsworthy, and nothing to worry about, then why would it *also* be something that is 'not allowed' to be discussed? Can something be both boring and taboo?

While it is true that many people, as argued by teachers, may not notice the gender gaps because they are a normalised part of the status quo, it is also true that many teachers feel that they must not talk about the issue. Most interviewees agreed that the gender gaps were being deliberately ignored, but not about why: was it because of the taboo or because of an attempt to live up to genderblind ideals? The genderblind ethos seems to be a modern blend of post-war ideals and the newer ones brought in by the 'individualisation' era of the 2000s onwards. The

former was homogenising, treating children the same regardless of their situation, and the latter advocates dealing with children according to their individual needs. Both prioritise minimising consideration of broad demographic traits like gender, race, or class.

There is indeed a feeling amongst many teachers that gender is too blunt an instrument to use for examining achievement disparities, with these teachers instead preferring to consider children purely as individuals. M1.3 explained that it is not that people are ignoring disparities, per se, but instead concentrating on "other factors" and "looking a bit more deeply". Teachers who worry that including gender and its potential impact in teacher training might lead to bias are one example of this 'zoomed in', individualised approach.

The genderblind approach's darker side is that of 'taboo'. It was striking how many teachers felt that gender was something that they should not even be paying attention to, and certainly not talking about in the same breath as achievement differences. Some teachers articulated their discomfort with discussing gender disparities during their interviews, while others seemed relieved.

Insiders such as researchers, as well as teachers, believe there is a deliberate effort to ignore the gender gaps by the government. This is convincing since the government is documented as having used statistics such as those in PISA for its own ends before – it is not that there is simply no interest in the results.

The taboo seems to be a malignant growth from the more noble ideal of the genderblind approach. Perhaps it emerged as a way of enforcing the genderblind norm. We saw in the literature review that the definition of 'equality' has long been a battleground for politicians, unions, and other proxies between left and right (Okada 2012). Historically, the post-war Japanese education system prioritised egalitarianism and the non-differentiating of children. It was vehemently against ability streaming, multi-track systems like vocational vs comprehensive secondary schools, and made efforts to allow children a pathway to success regardless of their socio-economic status. However, this approach came under political attack almost immediately.

Researchers documented a potential precedent to the genderblind taboo in that the discussion on social class and its impact on achievement suffered a similar fate for many years. The right wing refused to look into it in case it undermined their narrative that meritocracy was working, and the other side refused to concede that social background might have an impact on children in case it naturalised classism further (Okada 2012; Kariya 2018). The result was a 'taboo'.

I felt the full force of the taboo myself at a conference, where I found out that even mentioning the taboo was taboo. I had the good fortune to attend the one-day conference on increasing girls' interest and participation in STEM (focusing on science, rather than mathematics), and asked the panel of speakers the same question I asked in all my interviews: why did they think that the issue was not discussed? Without the rapport that the rest of an interview normally allowed me to build, I was careful to preface my question with how grateful I was to attend. However, the responses had little substance and bore no resemblance to the careful answers I had received from teachers. Even when they had been unsure, or sceptical generally, about the importance of gender differences or about why the topic was not on the agenda in Japan, they had said so clearly. The panellists' answers were mostly hedging and changing of the subject. Finally, the moderator stepped in and closed the Q&A. I was taken aback by this, but once the session was over multiple people in the audience immediately came over to give me their own answers to my question, and several people even expressed an interest in being interviewed themselves.

Does a lack of awareness and problematisation matter? Those teachers worried about introducing bias have a point, but it is difficult to see how things could change without it. However, many of their colleagues – and particularly the researchers – believed awareness reform (*ishikikaikaku)* was the most critical step to addressing the gender gaps. Indeed, the effectiveness of genderblind (or taboo) approaches have been questioned for years. Houston (1985, p.130) argued that gender cannot be ignored "without the risk of entrenching it".

One speaker at the conference I attended spoke passionately about how the hardest part of her decision to pursue an engineering career had been her high school teachers' lack of support. This is not just about promoting the idea that STEM could also be 'for girls' to girls themselves, but also making sure that teachers appreciate how much they could influence pupils' choices[14], especially if they understand the barriers girls face to choosing these subjects.

You cannot problematise something if it cannot be spoken about. If discussing the gender gaps is verboten – even with noble intentions – then this is another good explanator for the low levels of problematisation of the gender gaps issue in Japan.

Boring, Expected

It would, however, be difficult to say that the message about gender gaps is not being received just because it is telling Japan something that it does not want to know. We have seen that it could also easily be because it is something that they *do* know, but do not see as an issue. Researchers and teachers alike felt the non-problematisation of gender gaps in mathematics was generated, in large part, because it was a common sense, expected result. This was illustrated by the number of interviewees who, while exhibiting some momentary surprise at statistics like the large PISA gap, often went on to say things like "ah, but that's something I think I knew really somehow".

The literature review followed the problematisation process of several issues in Japan from recent decades; we saw that something being considered socially undesirable was often a prerequisite of such problematisation. However, in this chapter we noted that an explanation for why people may not pick up on gender gaps is because such gaps are considered perfectly acceptable. Interviewees pointed out that an oft-held attitude is that girls and boys are different, will therefore have different lives, and you could see this in the reality of the world outside. Some

[14] 14 See *Benesse* (2015) which found that teachers were the most influential after the mother (and were more influential than the father). This also accords with teachers' view that they would have the most responsibility after parents for fixing the gap, as per Chapter 6.

teachers held this opinion themselves, and others hesitated about the need to solve the gaps in case it disrupted the balance between men and women.

All this adds weight to the idea born from chapters 6 & 7: that structural gender inequality, and ideas about how girls' and boys' lives are expected to turn out, are blocking recognition and problematisation of the gender gaps. It is hard to problematise girls doing exactly what they are expected to, conforming to gender norms, and doing it all seemingly by choice of their own. Although there has been lots of attention paid to structural barriers women face in the workplace, there is less awareness of those that girls face in schools. Education, especially compulsory education, is perceived as fairly gender free – as isolated from the sexism and inequality in the outside world – which can help hide just how gendered the situation really is.

This chapter tries to place the difficulty teachers had in seeing and labelling differences they saw between boys and girls as 'gender differences' in a broader context. Whatever the exact (real) combination of causes we have explored here today, the end result is that gender gaps in mathematics have not been problematised by teachers. In fact, they have been problematised by almost nobody. The research conducted by organisations like the OECD, and a few other isolated researchers trying to make the situation known, has been greeted with silence.

From these interviews we can see that gender is very much a feature in the Japanese educational landscape. It only appears as if it is not because it is both so normal as to invite no curiosity, and paradoxically because so many actors at different levels are making concerted efforts not to discuss it.

For most teachers, gender is not a topic they encounter often, and most had never been explicitly invited to think about the gender gaps before – many even feeling that it is implicitly not allowed. Teachers, arguably the education system's most potent actors, did not have a consensus on the gender gaps in mathematics as a problem in need of solving.

In the final chapter of this thesis, we will tie all these threads together and examine them against the problematisation model proposed in the literature review.

Chapter 9 – Conclusion

In the final chapter of this thesis, we will attempt to do three things: summarise the main findings of each empirical chapter, consider the limitations of the research, and then pull together what we have learnt and discuss these in context.

9.1 Summary of Findings

9.1.1 Chapter 5 – Do Teachers See Gender Gaps?

Chapter 5 sets out to answer the first of our research questions: "What are Japanese teachers' perceptions of the gender gaps in mathematics?", including the subset of this question of whether teachers see gender differences at all. Yes, teachers do see gender differences in mathematics – even if their gut reaction might have been that there were no achievement (read: grade) differences in their own classrooms. We also introduced the concept that teachers might be basing this reaction off different kinds of measures of achievement, something highlighted when they were asked about PISA data. This chapter then set out the main categories of gender differences in achievement and behaviour/attitudes, before introducing the four main themes that help form an analytical framework used throughout the rest of the thesis.

9.1.2 Chapter 6 – Barriers to Recognition and Problematisation

Here, we explore the first angle of reasoning behind teachers' initial reaction that there are no gender differences: based off themes 1 (personality) and 3 (ability). First, we establish that teachers see the 'ideal mathematics student' and 'girls' very differently. Then, prompted by an investigation of teachers' perceptions of PISA data, we also explore the difference between 'being good at maths' and 'getting good grades' in teachers' eyes. Having understood that girls do not fit teachers' ideal profile of a mathematics student, and that teachers expect them to perform worse than boys on applied mathematics (or anything else outside the scope of textbook/classroom mathematics), we explore the three main reasons behind why teachers would say they do not see a gender gap. Credentialism: that they are basing their answer on classwork/progress test results

rather than wider evaluations of things like girls' application ability. Lenses: teachers do not consider things from a gendered perspective - but if this is not done then disparities are hidden or can be explained away. Innate and Inevitability: do teachers think the gap can (or should) be fixed? The perceived inevitability of the (innate or socialised) root causes affect what they count as a gender difference and prevent problematisation.

9.1.3 Chapter 7 – Choice and the *bunkei/rikei* Track System

Chapter 7 uses the other two themes – 2 (interest) and 4 (choice) – to examine teachers' reasoning from another angle. Here, the deeply gendered (and normalised) B/R system affects teachers' perceptions of pupil motivations, and therefore teachers' perceptions of their students' achievements, behaviours, and attitudes. The gender gap can hide in plain sight as the structure of the B/R system makes it harder to 'see' gender disparities for what they are – particularly as (theoretically) students make their own choice between the two tracks. The rest of this chapter uncovers how teachers feel about the B/R system, including its important and seemingly intractable position in the education system. Teachers' answers make it clear that they do see the societal constraints on their pupils which affect their choices.

9.1.4 Chapter 8 – Genderblind? Or Taboo?

Teachers reveal that they too have noticed that they are not supposed to be talking about gender – especially not with regards to how it impacts achievement. A combination of Genderblind and Taboo values, the sheer banality of mathematics gender gaps, and a lack of information and discussion have fused to equal no awareness of the gender gaps. Without awareness, without discussion, there can be no solutions. Chapter 8 also shows that there are potential problems to implementing any top-down solutions considering teachers' distaste for 'official' and collective responses to the gaps.

9.2 Limitations of the Study

As my interviewees were not randomly sampled, I am unable to make any useful quantitative analysis of the data even if it is numerated. A much bigger, random, sample of interviewees from a wider geographic area, and the inclusion of teachers from the elementary school stage would lend the findings of this thesis some generalisability. Only three interviewees were based in schools outside Tokyo – any differences that might be revealed if the research was repeated in, say, Hokkaido or Kumamoto prefecture would be particularly interesting.

This thesis posits that the B/R system makes a huge impact on teachers' perceptions. But to support this, I would also like to explore the opposite side of this system – do *bunkei* teachers feel similarly to the mathematics teachers but in reverse? Their own, opposite, gender profile may also have an impact – and how do male *bunkei* teachers feel about teaching a more stereotypically feminine subject and does this affect how they see their pupils?

There were advantages to the iterative style in which I conducted the research for this thesis. It allowed me to refine my interview schedule between rounds of fieldwork, and it was interesting to have a sample across time in the same schools (even the same teachers, in two cases). However, this means that a few of the later questions could not be asked in the earliest interviews.

It is difficult to prove a negative, and this thesis sets out to explain why an issue has *not* been problematised, rather than establishing how and why an issue *was* problematised. Without classroom observation, or access to grades (or other achievement data), it is impossible to evaluate how accurate teachers' perceptions are of their classrooms. This is in contrast to research such as that conducted by Walden and Walkerdine (1985) who collected this information for their analysis. Future research could be enhanced by being able to make this comparison.

9.3 Discussion and Overall Conclusions

Japan is in an unusual position. It is one of the world's most powerful economies. However, it faces a demographic crisis projected to threaten that position unless drastic action is taken. In part, this could be answered by improving women's participation, and retention, in the labour force, especially in the important STEM sectors. Even though evidence shows that school level decisions made by girls are a major barrier to achieving this participation, there is little discussion going on and no discernible problematisation occurring. Even when international testing; Japanese researchers' studies; and even government statistics themselves have provided a starting point for understanding, and to focus solutions on, there does not seem to be much feeling that the gender gaps in mathematics are an urgent problem to address.

However, objective conditions matter less than how they are perceived. Hilgartner and Bosk (1988, p.53) described social problems as "projections of collective sentiments rather than simple mirrors of objective conditions" - which explains how some things can become problematised while others are not. Whether it is the underrepresentation of women doing advanced STEM degrees, the internationally large PISA gap, or even the disparities that this dissertation's interviewees have described; we could expect these conditions to have kickstarted the problematisation process. For example, we have seen that other countries have problematised much smaller educational gender gaps than the ones in mathematics in Japan[15]. If we refer to the criteria for problematisation discussed in the literature review, we can see now that the response to the gender gaps fits few of them.

[15] For example, the UK is an average performer, with an OECD average gender gap in PISA. The Ministry of Education and the UK media's response to a much smaller gap is the opposite to Japan's. Gender is prominently featured in government reports on PISA, with commentary that includes discussion of this in context with GCSE result gender gaps (Jerrim and Shure 2016; Sizmur et al. 2019). Mainstream media covered the PISA results, including the gender gap in mathematics, in newspapers across the political spectrum (Boaler 2014; Coughlan 2014; Adams 2015; Duncan 2017; Gjersoe 2018; McInerney 2019) Future women and equalities minister Elizabeth Truss (2013) even wrote an article decrying the educational environment that created the gender gap. The UK gap was much smaller than the one that has gone ignored in Japan.

Powerful Actors & Importance of Discussion

A critical first step towards problematisation is the 'claims-making process'. Concerned parties draw attention to the putative conditions that they want addressed, and this is picked up by the general public/media/government to continue the process of defining these conditions as problems (Spector and Kitsuse 2001). Purportedly powerful actors, such as the OECD itself or individual researchers and journalists, have tried to raise the alarm about the gender gaps in mathematics, but have been largely ignored (Isa and Chinen 2014; Tanaka 2014; Nikkei.Style 2015). The evidence uncovered in this thesis helps us to understand why: there is no groundswell of 'claims-making' coming from teachers.

Teachers are important stakeholders in the education system. They not only have a direct impact on their pupils, but have avenues available to them for grass-roots professional development and to affect teaching in Japan on a wider scale (Doig & Groves, 2011; Fernandez & Yoshida, 2004; Isoda et al, 2007). If teachers did decide to throw their weight behind this issue it would likely be a different story. Yet we see that, amongst teachers, there is only tacit understanding and no discussion.

We set out to establish, not whether the putative conditions of the gender gaps such as those found in the PISA tests and the studies by Isa and Chinen (2014) and Uchida and Mori (2016) are 'real', but whether they were 'real' to the teachers themselves.

'No' was the gut reaction of many teachers when first asked about whether they saw any differences between boys and girls in their own classrooms. However, we were quickly able to address our first research question on whether teachers see gender gaps: the answer is we have seen that teachers do view their male and female pupils very differently – with different personalities, interests, abilities, and making different choices. We have also seen that teachers do feel these factors are the causes of gender gaps in achievement and attitudes/behaviours. The answers to our other research questions were more complex - why has nobody 'seen' the gender gaps?

Invisible

We explored how the gender gaps are concealed from teachers throughout the empirical chapters of this thesis. Depending on what metrics of mathematics ability a teacher prioritised, and what the threshold was to meet for it, teachers may not see the gender gaps in their own classrooms as a concern; they might not see any achievement gender gap at all if they were not looking specifically through the lens of gender – common gender differences such as the achievement gap widening or reversing over time are only visible if teachers choose actively to compare across year groups and across sexes. When teachers were asked to do so, as in this research, they found that the gaps were there. The gendered nature of the B/R system was also obscured by the fact that it is ostensibly subject preference (rather than gender) that sorts children into these two distinct groups. That the *rikei* track was almost exclusively male because girls were not choosing to continue with STEM subjects - even when they had shown a flair for, and interest in, mathematics in the past - was not questioned. The B/R system rendered the gender gaps during high school, and the cascade of incentive differences that the system provokes lower down the education system, invisible under current conditions.

Genderblind or Taboo?

The current conditions are that you are not supposed to notice, or talk about, gender in education – especially if it is about achievement. This idea popped up throughout the chapters; especially in Chapter 6 when discussing teachers using different lenses instead of a gendered perspective to look at their classrooms, but teachers themselves illuminated the scale of the situation in Chapter 8. Considering the wealth of gender differences that teachers revealed they saw during their interviews; we could guess that something might have been holding teachers back from considering things from a gendered perspective before. However, in Chapter 8, the teachers themselves confirmed that they too were aware of this.

Some teachers explained that the reluctance to think about gender, and its potential effects, was down to a noble, 'genderblind' ideal. Teachers should treat all children the same: as individuals. This itself seemed to be an interesting blend of the lingering effects of an old-school view of egalitarianism, and a newer value of individualisation born of the *yutori kyoiku* reforms (Okada 2012). Despite the mixed views on the success of the latter as education reform, it seems to have made *some* impact on how teachers see their role in education overall. Gender escapes scrutiny in either case - caught in the middle between an approach that it too 'zoomed out' to see demographic impacts, and one that it is too 'zoomed in' to see how a pupil's gender is impacting them. Taboo is the darker side of this genderblind ideal. Teachers explained that they did not feel that talking about gender disparities was allowed, even if these disparities were something that everyone knew about. Therefore, it is not surprising to hear from teachers that gender has never been discussed in lesson study groups, or other teacher training. Researchers, and some teachers, even accuse the government of holding back information about the gender gaps in mathematics.

No wonder teachers are not routinely using a gendered lens. Without it, however, things will slip under teachers' radar. School is seen as a relatively un-gendered time in a person's life (Okano and Tsuchiya 1999; Cave 2007), and this seems to be reflected in how teachers point more to the causes and factors that occur before (childhood socialisation etc.) or after (university entrance, life course pressures) their jurisdiction ends. Perhaps they do not think that it would be necessary, or even useful, to use the lens of gender. This is especially so as they can see other ways to explain the achievement and attitudinal disparities between boys and girls; boys catching up in terms of physical/mental development or girls simply taking an inefficient approach to being good at mathematics.

The pressures of credentialism also play a part in camouflaging the gender achievement disparity. We covered how and why the PISA gender gap might be larger than a similar test like TIMSS in the Rationale chapter. In Chapter 6, teachers confirmed these suspicions; a test that focuses on areas they perceive girls as being weak in – the application of prior knowledge, using

mathematical thinking, to new and unfamiliar problems based around the 'real world' - is a test that they would be unsurprised to see girls do poorly on – which they did, and which teachers were indeed unsurprised about. Considering that teachers are (latently) highly aware of where girls struggle, it is interesting that so many interviewees' gut reaction was that they did not see a gender gap in their own classrooms. This mystery is solved somewhat if teachers are basing this judgement on straightforward tests of classroom/textbook knowledge and the grades that show up on termly progress tests. Even then, we see from both the research by Uchida and Mori (2016) and the data split by sex that some interviewees had to hand, that there definitely are gender gaps even in these progress tests and classwork results (albeit seemingly not as large as those of PISA). Still, it is completely understandable that this is what teachers would base their initial response off. One of the most important aspects of their job is to make sure that children can get the grades they need to move on to the next stage, and this is measured in large part by progress tests and how students perform the curriculum content they have been taught. In the highly pressured and competitive 'credentialist' educational environment, without a prompt to consider whether there are gender achievement gaps in other metrics, it makes sense that they would fall back on prioritising a visible, important one like this. Teachers' perceptions of girls' own 'credentialism' plays a large role in the rationalisation of the B/R ratios (discussed below) too. The whole situation is so rational, so normal, that it does not attract any notice and therefore no problematisation.

Scale of the Issue

Unlike *kikokushijo*, the case of teen prostitution, or even the TMU scandal, this is not an isolated problem affecting a relatively small group of people. Instead, the gender gap issue has more in common with the 'exit' case of women opting out of marriage and motherhood – these are broad, large-scale conditions that are the aggregate effect of thousands of individual reactions by girls, their parents, and their teachers. The situation is too normal, too rational, and

too systemic to be 'seen' easily enough to be flagged as a problem that can – or even should – be fixed.

Injustice, Moral Outrage, and Agency

For the sake of argument, let us presume that the gender gaps are seen for what they are: any sense of injustice or moral outrage over the disparities is then neutralised by the fact that it can also be interpreted as fair.

Despite some similarities (both educational 'women in STEM' issues) the Tokyo Medical University (TMU) entrance fixing scandal is a world away where it matters; deliberately preventing girls with better grades from entering the university to alter the gender ratio artificially was considered profoundly unfair by the Japanese public (AsahiShinbun 2018; Wheeler 2018). There, girls wanted to be doctors, and had the grades to do it – why should they be discriminated against because of their gender? The protestations that it would be a problem to have many female doctors as women are more likely to leave their jobs (presumably due to maternity) cut no ice with the government, media, or the women they had wronged themselves.

Societal norms and gender roles ('because society') was not an excuse in their eyes. Yet we have seen that 'society' looms large in how teachers rationalise the gender gaps; whether pegging it as the main root cause of the gender achievement disparity (childhood socialisation, lack of role models etc -Chapter 6), or that girls make rational choices in response to societal realities (hostile STEM work environments, *bunkei* university programs easier to enter etc – Chapter 7). 'Society' is an unacceptable justification for the disparity in the TMU scenario, so why is it acceptable here with the mathematics gender gaps? That reason is choice.

The perception of agency is a key barrier to the problematisation of this issue. The reality of the gender gaps get lost in the push and pull between teachers perceptions of girls' agency, and their perceptions of the structure that confines it (Giddens 1984; Hughes 2002; Jones 2005). In Chapter 7, the themes of interest (2) and choice (4) are at their most prominent, and agency takes centre stage. The B/R system is extremely gendered but escapes scrutiny, not only because

it is so normalised, but because it is fundamentally still perceived as a student's own choice. This is the case even though teachers are well aware that this agency is also constrained – even the most serious proponents of the B/R explanation for the gaps like SH1 and T1 stress the impact that societal pressures place on girls making the choice between the two tracks. Teachers understand the consequences of a B/R choice for a child's future (the constraints of the 'structure'), and they accept what they perceive as girls' agency within these constraints. Cave (2016, p.211) also noted this respect for students' autonomy in his observations of teachers' guidance. He also comments that he never saw teachers giving any advice to girls that might stifle ambition; in fact, teachers seemed to try and protect their pupils from any pressure they were under from parents. That teachers are not trying to intervene against the societal pressure acting on B/R choices is telling. It seems likely that it is partly a reflection of just how normal the gender segregation in the 'outside world' is (and therefore how normal the B/R ratio is), and partly a reflection of teachers like SH.1 recognising what a high stakes move it can be for a girl to push against the tide and choose *rikei*.

Teachers were uncomfortable with the idea of officially single-sex education (no choice), but were fine with unofficially sex segregated classes like B/R (choice). In the 'exit' example presented by Schoppa (2006), there was disagreement over whether women making a rational choice and *choosing* not to get married or have children was actually a problem either; some prominent feminists framed this as a victory to be celebrated. Except, in this case, just because choice is officially the mechanism of B/R sorting does not mean it is a free choice. It may not be official sex-segregation, but it is systemic.

Choice plays a much lesser role in Chapter 6 – where the impact of personality (1) and ability (3) differences are foregrounded – but it is still there. In the background of the 'Good Girls Don't Get Ahead' explanation is room for the idea that if girls did things differently then the gap would at least reduce. If girls chose to be more like boys - took the same approach as boys to their learning and had the same interests - then they might get the same results. Teachers instead saw

girls as uninterested in mathematics beyond a utilitarian-test focus and struggled to think of ways to engage their interest. We can compare again to the TMU example; If girls are not as good at mathematics, and they do not want to do it anyway – what is there to problematise about the gender gaps?

That teachers did not report any angry parents up in arms about their daughter's mathematical plight also adds to this perception that the gaps are not a problem. In the case of the *kikokushijo,* the perception that the education system unfairly disadvantaged their children drove parents to become claims-makers and lobby for change (Goodman 2012). Yet none of the teachers (or researchers) see any parents doing the same for the B/R system – not even the parents of girls in the elite national schools, who seem exactly the kind of invested people who would.

Teachers' perception of their *own* agency in the situation also played a part in the (non)problematisation of the gender gaps in mathematics. Although they identified possible ways they could help improve girls' confidence (and interest, to a lesser extent) when asked about it specifically, most of the root causes of the gender gaps that teachers identified were practically inevitable even if they fall short of being technically innate. The perception of whether the gender gaps are even controllable is a key finding in whether teachers notice or problematise them: early socialisation, biological differences between the sexes, and the wider messages children receive from society are out of teachers' hands.

Gender Norms and Social Unacceptability

A related criterion necessary for problematisation, also missing in the case of the gender gap, is social undesirability and the breaking of gender norms. When it comes to the problematisation of teenage prostitution in the 90s, the perception that girls were going against traditional and acceptable modes of femininity caught the broader zeitgeist of societal anxiety over gender relations (Kinsella 2012). In the 'exit' example of problematisation, which occurred

even without an active group of claims-makers, government concerns over women opting out of motherhood and marriage were also inspired by this rejection of traditional gender norms and family structure (as well as by the economic implications) (Schoppa 2006). In both cases, women were perceived as breaking the 'rules' and this was part of why they were problematised.

Perceived deviance from gender norms and the social undesirably thereof is one of the deciding factors in what issues concerning girls are problematised in Japan. The gender gap issue does not fit the bill here either. Teachers describe girls in classically feminine and acceptable ways: they are quiet, polite, hard-working, neat, and organised. Girls are not expected to like, or to be good at, mathematics. They are not expected to work in careers that use these skills - recall the pushback from the people around them that female mathematics teachers report they experienced. My interviewees pointed out that the world outside reflects this, and that people are not surprised when girls follow that example. Many teachers do not see how girls living up to gender norms, and seemingly doing so completely of their own choice, is a problem. Crucially, even those teachers who seem dissatisfied about how few girls continue to study mathematics, and how skewed the STEM tracks are, are conscious that the 'outside world' does not seem to agree.

Information and the Media

Another way that this case differs from those we saw in the literature review is the (practically non-existent) media attention. In Chapter 8, teachers confirmed that they had seen nothing about the gender gaps in mathematics (including those PISA results) in the media and heard nothing from the government, colleagues, or other avenues like lesson study groups. Kinsella (2012) shows the vital role statistics, and their flow upwards through the layers of news media, played in the problematisation of the teenage prostitution issue. Although the numbers could be dubious, they were harnessed to attract huge attention. We have the opposite situation: the mathematics gender disparity has reliable statistics, backed up by Japanese researchers and from a source to which Japan normally pays a lot of attention. But even though the OECD (and

some individual journalists) have tried to draw attention to the gender gaps in achievement and attitudes there has been no problematisation. Not even the WEF's (2017, p. 27) statistic of $550 billion lost annually to gender inequality in Japan has managed to draw attention to the gender gaps in mathematics.

Cultural Zeitgeist and Debate

As with the problematisation of teenage prostitution, the *kikokushijo* case managed to catch the cultural zeitgeist and ride it towards wider problematisation. First, there were concerns over what was considered Japan's uniquely gruelling entrance exam system – which led the public to pity the poor *kikokushijo* who would be barred from competing – and then concerns over internationalisation and creativity which meant that they were reframed as potential economic saviours (Goodman 2012). Could Japanese girls not be the new economic saviours? Despite numbers like those of the WEF above, and former Prime Minister Abe's 'Womenomics' push to combat population contraction, there has been no similar attempt to try and harness all the wasted potential that the gender gaps in mathematics present – especially as so much of it stems (according to both the OECD and the teachers in this interview) from aspects that could be fixed like the confidence gap.

Other social issues in Japan were problematised as they were raised at a time when society was receptive to those problem being raised. So there is still a potential opportunity here for the gender gaps to be raised. There has been an uptick in the attention paid to issues of gender inequality in education more generally – the taboo over discussing the impact of socioeconomic class has weakened (Okada 2012; Kariya 2018). Outrage at politicians telling girls to stick to flower arranging over trigonometry (AsahiShinbun 2015); the fixing of medical school entrance exams to prevent 'too many' female students from being admitted; and a myriad of other criticisms in the wake of the international movements like Me-Too suggests that society may be arriving at a place where it more receptive to the issue. Perhaps the persistent chasm of attainment and attitudes in mathematics will soon be considered an unacceptable state of affairs.

Certainly, the eerie similarities to UK research from the 80s such as Walden and Walkerdine (1985)and Riddell (1989) – right down to quotes from our interviewees that could have been taken verbatim from theirs – suggests that a shift in public perceptions towards problematisation is absolutely possible. The UK's current attitude to mathematics gender gaps (for better or worse) is night and day compared to Japan's.

Problematisation theory, understandably, focuses on how issues are picked up and problematised. This research has shown that whether the conditions can even be 'seen' to be assessed for problematisation is another crucial consideration for this theory. Teachers hold one piece of the puzzle, girls and/or their parents will hold another, researchers and government ministers have vital information to add too. To bring these pieces together, there must be a concerted effort to raise awareness of the issue of gender disparities in mathematics. If this can be done, then these groups can work together to make sure that 'good girls *can* get ahead' and ensure that girls (and the Japanese economy) can reach their fullest potential.

Raise awareness. Get talking. Save the girls. Save Japan.

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Appendix I

Interviewee Code	Sex	Age	Agegroup	School Type	Public/State/Private	Ranking
Z14.1	Male	50s	Older	Middle	Public	Low
Z14.2	Male	20s	Younger	Middle	Public	Low
Z14.3	Male	30s	Main	Middle	Public	Low
Z14.4	Female	40s	Main	Middle	Public	Low
Z14.5	Male	40s	Main	Middle	Public	Low
Z14.6	Male	20s	Younger	Middle	Public	Low
X4.1	Female	30s	Main	Middle	Public	Low
X4.2	Male	20s	Main	Middle	Public	Low
BN3	Male	30s	Main	Middle	Public	Mid
GS.R	Female	50s	Older	Researcher	Researcher	N/A
KG.R	Male	50s	Older	Researcher	Researcher	N/A
KHW	Female	30s	Main	High	Private	Mid
KM1	Female	50s	Older	Middle	National	High
LND	Male	40s	Main	Middle	Private	Mid
NA1	Male	30s	Main	Middle	Public	Mid
M1.1	Male	50s	Older	Middle	National	High
M1.2	Female	50s	Older	Middle	National	High
M1.3	Female	30s	Main	Middle	National	High
M2.1	Male	50s	Main	Middle	National	High
M2.2	Female	30s	Main	Middle	National	High
SM.R	Female	50s	Older	Researcher	Researcher	N/A
SB1	Male	20s	Younger	Middle/High	Private	High
SK3	Male	50s	Older	Middle	Public	Low
SJP	Male	40s	Main	Middle	Public	Mid
SH.1	Male	50s	Older	High	Public	High
SH.2	Male	30s	Main	High	Public	High
T.1	Female	50s	Older	Middle	Public	Mid
T.2	Male	50s	Main	Middle	Public	Mid
T.3	Male	40s	Main	Middle	Public	Mid
TM	Male	50s	Older	High	Private	Mid
TO.1	Male	40s	Main	Middle/High	Private	Mid
TO2.1	Female	50s	Older	Middle	Private	Mid
TO2.2	Male	50s	Older	Middle	Private	Mid
B1.1	Male	50s	Older	Middle	National	High
B1.2	Male	30s	Main	Middle	National	High
B1.3	Male	20s	Younger	Middle	National	High
B2.1	Male	30s	Main	Middle	National	High
B2.2	Female	20s	Younger	Middle	National	High
B2.3	Male	20s	Younger	Middle	National	High
BH.Y	Male	50s	Older	High	National	High
WS1	Male	50s	Older	Middle	Private	High
YR	Female	50s	Older	Researcher	Researcher	N/A

TOTAL: 42

Teachers are grouped by their school (if applicable). Ranks are approximated. Age/Experience group refers to 20-30 (Younger/Newer) 30-50 (Middle/Moderate Experience) 50+ (Older/Experienced)

Teacher Tables

Sex	Interview Number
Female	10
Male	28
Grand Total	**38**

School Rank (Approximate)	Interview Number
High	17
Low	9
Mid	12
Grand Total	**38**

Age/Experience Groupings	Interview Number
Moderate	19
Older	13
Younger	6
Grand Total	**38**

School Type	Interview Number
Private	8
Public	17
National	13
Grand Total	**38**