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Mission Completed? Changing Visibility of Women's Colleges in England and Japan and their Roles in Promoting Gender Equality in Science

Abstract

The global community, from UNESCO to NGOs, is committed to promoting the status of women in science, engineering and technology, despite long-held prejudices and the lack of role models. Previously, when equality was not firmly established as a key issue on international or national agendas, women's colleges played a great role in mentoring female scientists. However, now that a concerted effort has been made by governments, the academic community and the private sector to give women equal opportunities, the *raison d'être* of women's universities seems to have become lost. This paper argues otherwise, by demonstrating that women's universities in Japan became beneficiaries of government initiatives since the early 2000s to reverse the low ratio of women in scientific research. The paper underscores the importance of the reputation of women's universities embedded in their institutional foundations, by explaining how female scientific communities take shape in different national contexts. England, as a primary example of a neoliberal welfare regime, with its strong emphasis on equality and diversity, promoted its gender equality policy under the auspices of the Department of Trade and Industry. By contrast, with a strong emphasis on family values and the male-breadwinner model, the Japanese government carefully treated the goal of supporting female scientists from the perspective of the equal participation of both men and women rather than that of equality. Following this trend, rather contradictorily, women's universities, with their tradition of fostering a 'good wife, wise mother' image, began to be highlighted as potential gender-free institutions that provided role models and mentoring female scientists. By drawing on the cases of England and Japan, this paper demonstrates how the idea of equality can be framed differently, according to wider institutional contexts, and how this idea impacts on gender policies.

Keywords

Gender equality policy, science education, women's colleges, ideas and institutions, comparative study

Introduction

Recently, governments as well as international organizations have sought to promote the equal status of women in many different fields. The four UN conferences on Women since 1975 have received international attention and served as catalysts for an international movement for women's empowerment and equality. The Beijing Platform for Action was signed by 189 governments at the 4th World Conference in 1995, and a ten-year review and appraisal of its implementation was held in 2005 at the UN headquarters in New York, as part of the UN Commission on the Status of Women's forty-ninth session (Burke 2004).

In response, national governments undertook various initiatives to promote the status of women and gender equality. On the global stage, each country is now compared against others based on indices such as the Human Development Index, Gender-related Development Index, and Gender Empowerment Measure (GEM)¹. In particular, the GEM underscores equality of opportunities in political and economic activities (e.g. the proportion of female legislators, senior officials, and managers, and women in professional and technical positions in each country). Moreover, the relationship between gender inequalities and economic growth has also attracted a wide range of

¹ The Geneva-based international non-profit organisation, the World Economic Forum, has published a report entitled Global Gender Gap Report annually since 2005, which covers and ranks 130 major and emerging economies. Thirteen out of the fourteen variables used for assessing inequality between men and women are based on publicly available data from the International Labour Organisation, the United Nations Development Programme and the World Health Organisation.

research interest, from domains such as feminist studies, macroeconomics, labor-market studies and social policy (Robbins 1999; Klasen 2002; Seguin and Grown 2006; Jütting and Morrisson 2006). Against this backdrop, gender equality in science, engineering and technology (SET) has been highlighted (Etzkowitz and Kemelgor 2001), and the goal of increasing the number of female scientists and engineers has become firmly ensconced on global policy agendas (European Commission 2000; European Commission 2006). Among the advanced industrial economies, the gender gap in these fields varies greatly. The ratio of women in SET subjects at degree level is generally high in Southern Europe. For instance, female students in science, mathematics and computing account for 58.1 percent of the total enrolment in Portugal and 54 percent in Italy, compared to 35.5 percent in the US, 29.9 percent in Germany and 19.9 percent in Japan. In the UK, the ratio is 41.9 percent, which means that it ranks in the middle. Also, in engineering, manufacturing and construction, Italy and Portugal score more than 30 percent, as of 2003 (European Commission 2006). The figure in the UK is below 20 percent, while it is only 11.4 percent in Germany and 9.2 percent in Japan. Therefore, although there are varying degrees of equality, it is common that governments seek to encourage more women to enter science subjects.

However, questions remain about the extent to which government policies are committed to bringing about equality through the promotion of women in SET and what their ultimate goals are, and about who plays a major role in implementing these policies. These are crucial questions for understanding not only the politics of gender equality, but also those of welfare states in transition, as the gender balance in these societies has major implications for education, for the economy and moreover, for the overall shape of each such country in the future (i.e. demographic changes) (O'Connor et al. 1999; Estévez-Abe et al. 2001; Iversen et al. 2005; McCall and Orloff 2005).

This paper seeks to address these questions, by outlining recent developments in two countries (England² and Japan) in terms of their respective government and academic community initiatives for supporting female students and researchers in SET. Although a convergence of policy directions can be observed in the two cases, which operate under similar external pressures and increasingly competitive education markets, a closer examination reveals different nuances and emphases in terms of their policy goals. The prominent role that women's colleges play in the government-funded schemes in Japan does not have a counterpart in England. While women's colleges in Japan discovered their niche in science education for women and became agencies for change, those in the UK have steadily diminished in their visibility in the public domain. The paper analyses the discussions concerning the role of women's colleges and universities in scientific fields in both countries by underlining the importance of predominant discourses. The purpose is to compare and contrast the current status of all-female education institutions in England and Japan, and how their legitimized roles in fostering female scientists has boosted the image of women's universities in Japan, but has not helped their counterparts in England to reverse their declining fortunes.

The paper explains the contrasting fates of single-sex education at university level by using the two different dominant concepts prevalent in the two countries: 'gender equality' and 'equal participation' (*Danjo Kyōdo Sankaku Kyoku*). The former is championed by most Western feminist movements including that in the UK, which have brought about changes in laws and social practices over many years. It emphasizes the importance of individual freedom from gender stereotypes. In contrast, the latter is supported by the long-held notion that women's roles at home as wives and mothers need to be equally valued as men's (Buckley 1997). The emphasis in the latter concept is placed upon a collective contribution to society as a group rather than in terms of individual achievements. As a result, gender distinctions are re-emphasized in the latter case, while the former has a tendency to project women as one of many minority groups (including those based on ethnicity and sexual orientation). These two contrasting concepts have played a major part in determining various actors' roles and public perceptions towards women's colleges in their respective countries.

² For this paper, we are using England for ease of reference, although UK government policies on women in SET are aimed at all four administrative units in the United Kingdom (England, Wales, Scotland and Northern Ireland).

The paper consists of four sections. First, it accounts for the two concepts, combined with brief histories of women's colleges and female scientists in each of the two countries. Second, education policies towards girls in science in the postwar period in each will be outlined, and some examples are highlighted as illustrative of the two ideas. The corresponding efforts made by academic institutions and communities also illustrate the differences. They will be explored with an emphasis on women's voluntary support networks and radical interventions in science education in England, which were lacking in Japan. Third, the relationships between women's colleges and gender equality in science education in the two countries are compared and contrasted by demonstrating different opinions about them in the print media and from interviews. The interviewees were academics and administrators engaged in fostering female scientists at women's colleges and universities, or other institutions closely affiliated to them. In cases where they were possible, semi-structured interviews in person were undertaken, while in other cases, a questionnaire with interview schedule was sent and returned via post or email. The respondents were selected based on their formal and active involvement in promoting and mentoring female scientists. The rationale for this selection was to understand views and perceptions of stakeholders in the roles of women's colleges in science education. Their first-hand knowledge and experience at the 'coal-face' were able to fill the gap between the public image of women's colleges portrayed in the media and the reality. Although some of the respondents are administrators of women's colleges, representing and defending their institutions, the interview schedule and the questionnaire sought to tease out both the advantages of women's colleges and the challenges that they face. As a result, we obtained fifteen participants (thirteen female, two male). Two male respondents were former scientists (now administrators) from Japan, who support 'equal participation of men and women'. The lack of success in recruiting male respondents in England limits the analysis to some degree, although it reflects the relative disengagement of men in the issue in England, compared to Japan. The fourth section summarizes the analysis of this interview/questionnaire data (N=15), particularly their opinions as to the current and future roles of women's colleges in fostering female scientists.

A two-country case study approach is used for this research. In order to trace the different trajectories of change and public perceptions in two countries, views expressed in the print media of each country are examined. Articles from major broadsheet newspapers for each country were collated from the period 1990-2008. The debates around women in science, as presented in these newspapers, were examined over time to gauge shifting patterns of views towards women in SET and women's universities. Although women's colleges in Cambridge and Oxford were founded as elite institutions, and also differ greatly from women's universities in Japan in their governing structures, the discourse analysis below focuses primarily on how all-female education at the tertiary level is perceived by the general public in each case. Therefore, the comparability of these two countries in this case study can be sustained. In most European countries, all-female universities do not exist. Unless otherwise stated, translations of Japanese quotes are our own.

The following section will first introduce the historical backgrounds to women's colleges in England and Japan, followed by an examination of the policy initiatives undertaken by both governments and academic communities with regard to support for women in SET.

Origins of women's colleges and the two contrasting ideas: 'gender equality' and 'equal participation'

Women's advocacy and feminist movements date back to the 19th century both in the UK and Japan, albeit with different emphases, degrees of impact and different rates of progress. When it comes to education for women, the major colleges for women were founded in the latter half of the 19th century or in the early 20th century in both countries. In England, these include Girton College (1869) and Newnham (1880) at Cambridge and Lady Margaret Hall (1878), Somerville (1879), St Anne (1879), St Hugh's (1886) and St Hilda's (1893) at Oxford, Westfield College (1882) and Bedford College (1849), which later became the Royal Holloway in 1879. In Japan, the best known are two public

universities: Ochanomizu (1875) and Nara Women's University (1908). Three private universities are also prominent: Japan Women's University (JWU, 1901), Tokyo Woman's Christian University (TWCU, 1918) and Tsudajuku College (1900). In between the two world wars, another effort was made by men to establish women's universities specializing in medicine and science³. There are now (as of 2008) 82 women's universities (and two-year colleges) in Japan (Asahi, 16 September 2008).

In England, although Newnham has thus far remained a women's college, alongside with two other women's colleges established after the WWII (i.e. New Hall⁴ in 1954 and Lucy Cavendish College in 1965), all the other historical women's colleges eventually opted for co-education, mostly during the 1970s and 1980s. On the other hand, in Japan, the five women's universities mentioned above are still, in principle, women's colleges, with a few exceptions in the form of course offerings in which men are now allowed to participate. Teaching staff are mixed at these women's universities in Japan, unlike at Newnham and Lucy Cavendish College, where only female fellows are allowed to join.

This contrasting situation arose partly due to the origins of these colleges in Japan. The two national universities were designed as teacher-training institutions for women, and Japan Women's University was founded with the specific goal of fostering a woman to become a 'good wife, wise mother' (*ryōsai kenbo*). By contrast, in the UK, the historical origin of women's colleges was to provide women with opportunities to study at educationally elite institutions (Oxbridge) on par with men. Such colleges were established, to some degree, thanks to grass-roots campaigns to open access to higher education to women, while in Japan, most of the colleges were founded by the state or male Christian philanthropists, who were influenced by what they saw in the United States or the UK. The initiatives responsible for the founding of similar colleges in Japan came from men inspired by their experiences in the United States, who felt the need to create separate female-only institutions, and were more in tune with the overarching emphasis on the cultural logic of the family (i.e. 'good wife, wise mother').

The term 'good wife, wise mother' (*ryōsai kenbo*) was coined by a pioneer in women's education, Masanao Nakamura in 1875, and began to represent the ideal for womanhood in the late 1880s and early 1900s (Sievers 1983). The Meiji government sought to promote family values under this banner (Kuwahara 2001). The original idea had much deeper historical roots. It derived from an old Confucian idea and the well-known textbook, 'Greater Learning for Women', written in the Tokugawa era (1600-1867). Although its direct impact on the new education system under the Meiji government is unclear, Sekiguchi (2010: 14) recognizes, from her analysis of historical archives, that not only Western thought but also some Confucian ideas had an influence on the Peers School for Girls (*Kazoku Jogakkō*) inaugurated in 1885. Through the new education system, the phrase 'men pursue their duties without, while women govern within' became embedded in Japanese social norms, with a few exceptions being made for the women intellectuals who went on to study at the leading research universities both in Japan and abroad in the early 1920s. In 1913, Tohoku Imperial University allowed three women to study science and mathematics for the first time (Kuwahara 2001: 207). Among them were Chika Kuroda (chemist, 1884-1968, Ochanomizu) and Umeko Tange (dietician, 1873-1955, JWU), who both previously obtained degrees from women's colleges. Despite a short period of strong feminist movements, women's universities (including two-year colleges) remained the most desirable choice for many wealthy and middle-class families for a number of years, as the other options were seen as being too risky for their daughters' future in society. In 1950, women entering universities and two-year colleges accounted for only 1.2 per cent of the total eligible population.

Exemplified by the 'good wife, wise mother' ideal, the difference between the feminist movements in the Western societies and Japan is often described in terms of the latter focusing less on individual

3 The Imperial Women's Medical and Pharmaceutical College was founded in 1930, followed by the Imperial Women's College of Science in 1941. Although the latter produced a prominent geochemist, Katsuko Saruhashi, the college became co-educational in 1950. Tsudajuku College introduced science in 1943 in order to meet the wartime need for women in SET.

4 New Hall College has been renamed as Murray Edwards College as of 2008.

autonomy and more on the family system. Buckley (1997: 278-279) argues that “(i)n any East Asian culture you will find that women have a very tangible power within the household. This is often rejected by non-Asian feminists who argue that it is not real power, but (...) Japanese women look at the low status attributed to the domestic labor of housewives in North America and feel that this amounts to a denigration of a fundamental social role – whether it is performed by a man or a woman”.

Therefore, although historically women’s colleges and universities in both countries have an excellent track record of producing distinguished scientists and prominent alumna in various fields,⁵ their original purposes and the expectations placed on them by their respective societies differed from the time of their creation. Accordingly, their long-held images and reputations diverged over time. The main aims of women’s colleges in Japan remained to foster a group of female teachers consistent with the ‘good wife, wise mother’ (*ryōsai kenbo*) image, which satisfied the needs of schools, companies or corporations and in turn enjoyed good reputations over many years.⁶ Hence, it was natural that this concept of ‘good wife, wise mother’ was seen as being amenable to the recent catchphrase ‘equal participation’ between men and women (*Danjo Kyōdo Sankaku*), when the government carefully selected the relevant words by rejecting the use of ‘gender’ and ‘equality’ in the 1990s. Although the Office of Gender Equality (to give its official English title) was set up within the Cabinet Office in 1994, the Japanese title for this office was more ambiguous and nuanced, namely the “Office for promoting equal participation of men and women”.⁷ In sharp contrast, women’s colleges in Cambridge and Oxford had a much more international outlook and generated prominent feminist campaigners who pushed through an equality agenda based in society, rather than in the household. The tenacity of the ‘family’ perspective in Japan led to a strong resistance to any commitment to gender issues in a wider political context, while the ‘equality’ agenda began to dominate in England at a much earlier stage.

The following sections will describe the differences between the two countries in their post-war education policies as well as their respective academic communities’ efforts to overcome barriers for women in SET with a particular focus on the influence of the two dominant concepts.

Setting the scene: post-war education policies and the main proponents for change

In the UK, the 1975 Sex Discrimination Act was the first piece of legislation which provided a framework for discussing sex differentiation in education as a policy issue. The Equal Opportunities Commission (now the Equality and Human Rights Commission) was instituted as a body to gather evidence of gender inequality and monitor an improvement process (Arnot et al. 1999: 71). In Japan, although the Law for an Equal Employment Opportunity for Men and Women was enacted in 1986 as a response to international pressure deriving from the UN Convention on the Elimination of all Forms of Discrimination against Women, the Basic Law for a Gender-equal Society was only enacted in 1999, which was more than twenty years after its counterpart legislation in the UK. Accordingly, the

5 In the UK, alumnae include the engineer Hertha Aryton (1854-1923, Girton), biophysicist Rosalind Franklin (1920-1958, Newnham), chemist Dorothy Hodgkin (1910-1994, Somerville), pharmacologist Baroness Greenfield (1950-, St. Hilda’s) and astrophysicist Dame Jocelyn Bell Burnell (1943-, Ph.D from New Hall). In Japan, apart from the above-mentioned two scientists, the mathematician Shihoko Ishii (1950-, TWCU), earth scientist Katsuko Saruhashi (1920-2007, Imperial Women’s College of Science) and chemist Reiko Kuroda (1947-, Ochanomizu) are some of the well-known names.

6 A good indicator of the reputation of traditional women’s universities can be the record of overall success for their graduates in the job market. The ratio of graduates who started off their careers in large corporations such as Hitachi, Toshiba, Fujitsu and Canon is known to be very high (roughly thirty per cent). In 2007, among the top twenty in this league table, four were women’s universities (Weekly Economist, 2007).

7 This was clear in the parliamentary debates leading up to the passing of the new law. The opposition party member Yuiko Matsumoto raised a question in the House of Representatives Cabinet Committee on 6 March 1996, highlighting a difference between government’s final plan (The 2000 Plan for Equal Participation of Men and Women) and some policy consultation documents (notably the paper Vision for Equal Participation of Men and Women) in the way ‘gender’ was conceptualized. Notably, the terms ‘gender free society’ or ‘gender equality’ were not included as ultimate goals.

Office of Gender Equality was upgraded to the Bureau of Gender Equality (*Danjo Kyōdo Sankaku Kyoku*) within the Cabinet Office, with responsibility for planning and coordinating the gender equality policies of the government. The Council for Gender Equality, chaired by the Chief Cabinet Secretary, was given the remit of monitoring the implementation of all the gender equality policies of the government.

The two-decade gap between the two government initiatives reveals in itself how the underrepresentation of women in society, including SET, was perceived differently by the political classes in the two countries. Some further examples of post-war education policies in the UK and Japan illuminate the contrast even more sharply, and this had significant implications for the fates of women's colleges into the 1990s.

In the UK, the Department of Education and Science produced a report concerning the O-level choices made at state-run schools in England in 1975. The report underscored the differences in subject choices between boys and girls, and the fact that some 'masculine' subjects (such as mathematics and physics) were not offered to girls (Department of Education and Science 1975: 11-12). The subsequent report from the Department for Education and Science, *Girls and Science*, published in 1978, raised concerns over factors which were thought to be influential in girls' rejection of science subjects. The factors mentioned included societal stereotypes, the family environment and the gender stratification of the labor-market as well as the science curriculum (Department of Education and Science 1978). Following the findings of the government as well as other academic communities, several school-based experiments were undertaken, some of which adopted a radical feminist approach to tackle the more structural issues such as the power relationships between boys and girls in the classroom. One prominent example of the strategies developed to increase the number of girls specializing in physics includes an experiment of curriculum redesign and single-sex teaching at a mixed comprehensive school in Nottingham (Price and Talbot 1984). Furthermore, two lecturers at Manchester University and Manchester Polytechnic conducted a longitudinal action research project, *Girls Into Science and Technology*, by providing opportunities for teachers to learn about sex-role socialization and for pupils to have role models and work experience in non-traditional fields (Phipps 2008). Such initiatives were observed across the country until the National Curriculum was introduced by the government through the Education Reform Act in 1988, reinstating more standardized science teaching. Universities were not exempt from the more competitive quasi-market system now in place, requiring strategic responses from each institution. Constant scrutiny of the performance rankings of schools and universities led to substantial decrease in the sex segregation of subjects at GCSE level by early 1990s, as Francis (2000) observes. With the support of local industries, institutions including former polytechnics signed up for projects which encourage and help fifth- and sixth form girls to choose SET subjects in higher and further education. Gender equality in science education, at least at the formal institutional level, became increasingly embedded as a way of survival for universities in the UK.

The situation in post-war Japan was quite different. In response to the high demand for rapid economic growth, the Japanese government reinforced traditional gender roles ('men pursue their duties without, while women govern within') through the national curriculum. In 1958, the Ministry of Education introduced gender discriminative courses at secondary schools. A standard course on technology was offered to boys, while home economics was provided as a course for girls (Ichibangase and Okuyama 1975). A suffragette and politician, Fusae Ichikawa (1893-1981) launched a campaign against this gender discriminative policy in 1974. However, it continued until 1989 when the Ministry finally made home economics a co-educational course, mainly as a response to the above-mentioned UN Convention on discrimination against women (Kamiko 1991). The general tone of the national curriculum meant that sex discrimination was the norm, and single-sex education at secondary and tertiary levels was widely accepted until the 1990s. However, the issue of the underrepresentation of women in SET was recognized by the Science Council of Japan (advisory body to the Prime Minister) in the mid-1970s. Nonetheless, a survey conducted between 1982 and 1984 primarily highlighted the difficulties of working mothers (e.g. childbearing and child care) without making specific references to inequalities between men and women (Kuwahara 2001). In the period between the 1960s and the 1990s, a few efforts were made by feminist scholars to strengthen the weakness of the voices calling

for equality. For instance, the Women's Studies Association of Japan was founded in 1979. However, feminist scholars and the public never entered into a debate about how the male dominance in SET subjects could practically be altered. In the face of the absence of many successful female scientists, women's studies institutions such as the Institute for Gender Studies (established in 1996) at Ochanomizu University, the Centre for Women's Studies (founded in 1990) at TWCU and Tsudajuku College began to feature some prominent alumnae in SET in their publications⁸. In 1992, the Faculty of Home Economics at JWU was reorganized into the Faculty of Science, following the two national women's universities (Ochanomizu and Nara, both with the Faculty of Science established in the 1950s).

As we have seen, by the 1990s, the spread of feminist discourse in science education (both in terms of policy and practice) in England had been remarkably different from that in Japan where traditional gender roles were emphasized. In England, gender equality was embraced by universities, not only because of the prevalent ideological stance, but also because of increasingly fierce competition in education and pragmatic approach to the labor market, which needed skilled workers irrespective of gender. The major shift in focus from the education sector to industry was observed in the White Paper, *Realising our Potential: A strategy for science, engineering and technology* (Cabinet Office, 1993). This paper was considered to be pivotal in recognizing the importance of female scientists as a great human resource, one which had been previously underestimated. In the following year, *Rising Tide: A report on women in science, engineering and technology* (Cabinet Office, 1994) was published, and as a result, a Women in SET Development Unit was established under the Department of Trade and Industry (DTI). Launched by Margaret Thatcher, 1984 was designated as the Women into Science and Engineering (WISE) year, which set the WISE campaign into motion. In the main, one-off educational programs received funding from the Department of Trade and Industry, NGOs, and various corporations. Although WISE is often perceived as employer-driven rather than as focused on education, it has been the most successfully funded campaign of its kind to date. Therefore, there was a strong sense that equal opportunities should be provided by the labor market for women in SET. In other words, it was the expression of a concept of equality under a neoliberal market logic. In England, there was a sense that women's colleges had had a time of their own, but their missions were now over. Because virtually all colleges are co-residential at present, students at other colleges think of those at Newnham as 'lesbians, vegetarians, or perhaps both' (Miller-Bernal 2006: 358). Their well-known involvement in left-wing movements does nothing to counter their negative perception.

In Japan, the primary political agenda since 1989 has been the decreasing fertility rate and the crisis of the family. The Law for an Equal Employment Opportunity for Men and Women has been criticized as the main cause for this crisis. From this point of view, gender equality from a feminist perspective has been constantly perceived as a possible threat which could further dismantle families. Therefore, while women's colleges in Japan discovered their niche in science education for women and became agencies for change, those in England have steadily diminished in their visibility in the public domain.

The next section examines public perceptions of women's colleges in the print media in the two countries, and compares their roles in science education with the help of the interview data.

Women's colleges and their roles in science education

Into the 1990s, the debates in the UK concentrated on whether or not female-only education was the best and fairest way to proceed into the 21st century. Although the issues surrounding women's colleges did not feature much in the print media, when they did, the articles carried both positive and negative comments about them. At the same time, experiments using a radical feminist approach continued mainly in co-educational environments. The Open University set up the *Women into Science and Engineering Working Group* in 1984. In Physics, the *Supported Learning in Physics Project* ran for five years, between 1994 and 1999, employing a radical context-based approach to the study of

⁸ The Institute for Gender Studies, Ochanomizu University, Catalogue of Chika Kuroda's Archives (2000); Women's Self-support and Science Education: A History of the Science Department of Tsudajuku College (1987).

physics for girls. In the Yorkshire and Humber region, the *Let's TWIST* project was led by Annette Williams at Bradford College, in partnership with Sheffield Hallam University. It was developed to raise schoolgirls' awareness of the opportunities in SET by making use of a "radical feminist framework focusing on the masculine culture of manual trades", and aimed at "empower[ing] women through teaching them traditionally masculine skills" (Phipps 2008:108). Its partner, Sheffield Hallam, delivered a similar program, as well as teacher-training in gender equality with the involvement of local industry. *Let's TWIST* was supported by the Joint Intervention (JIVE) Partnership, funded by the European Social Fund under the EQUAL initiative.

In terms of roles played by women's colleges in these processes, their input was minimal. By the early 1990s, their declining presence was already evident in both Cambridge and Oxford, with historic colleges such as Girton (Cambridge), and St Hugh's and Somerville (Oxford) opting to become co-educational in 1977, 1988 and 1992 respectively. In the case of Cambridge, the beginning of co-residency at three men's colleges 1972 meant the end of advantageous positions long held by women's colleges. Women students began to enter more prestigious men's colleges 'particularly if they were interested in the sciences' (Miller-Bernal 2006: 336). However, even in the 1990s, there was some input from these colleges, however small. The Association for Women in Science and Engineering (AWiSE) was established by chemist, Newnham alumna and government committee member Joan Mason. Although AWiSE lost momentum nationally after founder Joan Mason sadly passed away, its Cambridge branch CamAWiSE survived and remained active. Current members of CamAWiSE tutor female students in SET subjects and play a major role in organizing various activities, coordinating them with the university and local authorities. In 1999, the *University of Cambridge Women in Science, Engineering and Technology Initiative* (WiSETI) was established by Nancy Lane of the Department of Zoology and Felicity Hunt, Head of Equality and Diversity. WiSETI had its origins in 1993 when the Opportunity 2000 Campaign was established to pursue the goal of increasing the quality and quantity of women's participation in the workforce (Cambridge University website). This is an area where the presence of a women's college is strongly felt. Lucy Cavendish is particularly keen to help those with first degrees in SET subjects to return to work in the private sector or in academic positions after baby births and maternity leave (E-2). The scheme was supported by both industry and academic institutions such as Microsoft Research, Intel Cambridge Research, Queen Mary University of London and the Oxford Internet Institute. It is also supported by Newnham College. Nonetheless, commenting on the lack of a clear link between various policy initiatives and support for women's colleges, one tutor at Cambridge noted that 'what government wants to support is not female scientists on the top of the ladder in academic world, but [to] produce more girls with arithmetic skills for the labor market' (E-1). The special qualities of women's colleges, therefore, in terms of guidance and support, are rather secondary. .

In the Cambridge league table, it was reported that the two remaining women's colleges, New Hall and Newnham, were in the bottom three alongside Magdalene and Anne Lonsdale. New Hall's president had to defend its record by saying "Science in Cambridge tends to have a higher percentage of firsts than arts. More men do science, therefore there are more firsts in mixed colleges" (The Independent, 11 August 1999). The unpopularity of women's colleges among sixth formers was also raised as an issue. The main argument could be succinctly summarized by the following: "(...) many would argue that the time for Oxbridge women's colleges has now passed. After all, things have moved on, haven't they?" (The Guardian, 5 September 2002). One after another, the women's universities went mixed. These issues dominated the print media. In March 2003, St Hilda, Oxford University's only remaining women's college, held a vote by the governing body to decide on whether to admit men. Those who were in favor highlighted the difficult situation both financially and academically. The difficulties surrounding women's colleges were voiced more strongly than before; "In the past, when a teaching vacancy arose in a woman's college, the college easily filled the post jointly with the university, which shared the cost. That does not happen now, partly because the women themselves wish to join mixed teaching bodies. The former women's colleges do not have the endowments of the older institutions and cannot afford the 1 million pounds it costs to set up a science fellowship" (The Guardian, 13 May 1997).

Yet, a journalist and alumna of Newnham College Cambridge, Joan Bakewell, advocated the existence of women's colleges by saying "Fifty per cent of Oxbridge students may now be women, but the upper echelons of university posts are still steadfastly male. At Oxford 75% of lecturers and 90% of professors are men. Only 5% of chemistry tutors are women. Only 20% of college fellows are women. There is still a long way to go until the changed ratios that have so transformed undergraduate life reach those in the hierarchy above them" (The Independent, 14 March 2003). She emphasized the bleak prospects for women trying to obtain university lectureships in sciences and engineering.

Nonetheless, efforts continued to be made across the country on a larger scale. 'Equality and diversity' became a widely accepted agenda for all universities and academic communities to pursue. The Athena project was established in 1999 and based in the Royal Society to reverse the consistent loss of women employed in SET at each successive level of education and industry, and more specifically, to increase the representation of women in senior posts in higher education. It was supported by the UK higher education funding councils, UniversitiesUK, the Office of Science and Technology, and the DTI (Institute of Physics, website).

In 2002, the then Secretary of State for Trade and Industry, Patricia Hewitt, appointed Baroness Susan Greenfield to advise on a stronger and more strategic approach to addressing the issue of female under-representation in SET. Based on her recommendations, the government published its response *A Strategy for Women in Science, Engineering and Technology* in April of 2003 (Department of Trade and Industry, 2003). In order to overcome the barriers that prevent women and girls from entering, staying, and succeeding in SET education and employment, the government decided to set up the UK Resource Centre for Women (UKRC) in SET and to invest £1 million per annum in it. The government's strategy can be summarized by reference to three major key resources: funding, information and networks. Those resources are pooled at the UKRC for mentoring and networking, building up a database for knowledge transfer, and enhancing the employment prospects for women in SET in both the public and private sectors. Four core partnership universities were selected through competitive tendering, and the UKRC started with Bradford College, along with the Sheffield Hallam, Cambridge and Open Universities.

In Japan, after the milestone legislation the Basic Law for a Gender-equal Society was passed, 'equal participation between men and women' became a widely used phrase. In 1999, the Cabinet Office launched annual surveys on the perceptions of the general public about the issue of gender equality. Their findings and other data demonstrated the stagnant nature of the situations surrounding both women in general and female scientists in particular. When the central government ministries were radically reorganized in 2001, the Council for Science and Technology Policy (CSTP, *Sōgō Kagaku Gijyutsu Kaigi*) was newly created under the control of the Cabinet Office as the nation's highest science advisory body.

Soon after gender equality was incorporated into government policy, there was a crisis for a lot of women's colleges, especially in rural areas. By 2000, in the Southern part of the country, women's universities began disappearing due to reorganizations, mergers, or their transformation into co-ed institutions. Although most women's colleges in the area provided formerly popular two-year courses and degrees, there were some 'historic' institutions with four-year university status such as Fukuoka Women's University, which was founded in 1923. With the number of applications decreasing, the then Director of the university, Mamoru Tokumoto expressed concern about the future, underlining the issue of 'equality'. "Formally, equality between men and women has already been achieved, but in reality it has not. Moreover, apart from human rights, there is another important issue about 'respect for different characteristics' which exist between men and women" (Asahi, 29 July 2000). The comment was made in defense of women's universities, but it also revealed a hint of a patronizing attitude, which contrasts with the notion of 'gender equality' as exemplified in the English case.

In a major shakeup of the national universities that took place at the time, there was a debate concerning the future of Ochanomizu University. A merger of Ochanomizu University with other co-educational institutions was considered on the basis that a publicly-funded university should not

discriminate against men, now that the principle of equal participation had become stipulated in law (J-1).

However, the tide has turned as the government has begun to recognize the need to support women's universities by setting up grant schemes for fostering female scientists. In 2002, with the initiatives of the Japan Society of Applied Physics, the Physical Society of Japan and the Chemical Society of Japan, the Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering (EPMEWSE)⁹ was founded. In 2003, EPMEWSE conducted a survey commissioned by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), and received almost 20,000 responses. This large-scale survey's results "elucidate[d] the day-today activities of people working in the science and engineering fields, such as their working environments and family lives" (EPMEWSE survey report 2004: 3). The survey also highlighted differences in the working environments of academic institutions and private companies. Interestingly, collaboration between different academic associations was also promoted under the banner of the 'equal participation of men and women' rather than 'equality'. One interviewee remarked that "an openly feminist approach is an obstacle rather than a facilitator for change in Japan and it is very important to have men on board to improve the working environment for women, as (the male-dominated) society's mentality needs to be altered" (J-2).

The then Director of Nara Women's University, Masako Niwa, emphasized the fact that the number of female science students at Nara and Ochanomizu (the two national women's universities) was equal to that of the seven largest national universities combined. Also, the total proportion of female teaching staff was 36 per cent at Ochanomizu and 23 per cent at Nara, which came in at no.1 and no.2 in the list respectively.¹⁰ The data confirmed that women's universities were "better suited for providing role models for girls" in science as well as other subjects (Mainichi, 2 December 2002). The headline of this article read "liberation from 'womanliness'" (Mainichi, 2 December 2002). Simultaneously, the merit of sending girls to independent all girls' schools was recognized by the scientific community (Asahi, 15 November 2005).

In 2004, it was revealed that Japan ranked lowest amongst the 30 OECD member countries in terms of the percentage of women in the scientific workforce (11.1 percent). Women account for 25-35 percent in the other OECD countries. The CSTP reacted to this, and set targets for the proportion of newly available permanent positions that would go to women in the Third Science and Technology Basic Plan in 2006 (Cabinet Office, 2006).¹¹ The presence of the formerly invisible Minister for Gender Equality¹² became more strongly felt in the public domain; Kuniko Inoguchi was appointed to this post by Jun'ichiro Koizumi in 2005, and she actively campaigned for women in science. Instigated by the EPMEWSE survey findings and the following targets set by the Cabinet Office, the MEXT decided to invest 500 million JP Yen (GB£7 million) in ten institutions' projects over three years through a competitive selection process. The ten universities with successful bids were: Hokkaido, Tohoku, Tokyo University of Agriculture and Technology, Waseda, Ochanomizu, Tokyo Women's Medical University, Japan Women's University, Kyoto University, Nara Women's University, and Kumamoto University. Additionally, it was also decided that 140 million JP Yen (GB£1.2 million) would be set aside to fund 2-year fellowships for 30 scientists who had put their careers on hold to start a family (MEXT, 2005). Women's universities in Japan have made a recent comeback, and due to their well-established reputations for fostering scientists, it was possible for government funding to be targeted

9 As of 2008, full membership had been given to 38 academic societies, and observer status to 29 societies (see <http://annex.jsap.or.jp/renrakukai/outline.html>).

10 The high proportion of female teaching staff in SET is also remarkable in private women's universities such as Japan Women's University (32 per cent) and Tsudajuku University (28 per cent), compared to the two major private universities, Waseda University (4 per cent) and Keio University (19 per cent), as of 2008 (data provided by Japan Women's University).

11 Although the overall recruitment target for female researchers in the natural sciences is 25 %, specific targets vary by field: 30% for health and life sciences, 30% for agricultural sciences, 20% for physical sciences, and 15% for engineering.

12 In Japanese, *Shōshika Tantō Daijin* means "Minister for Tackling the Low Fertility Rate".

towards them. Yet emphasizing this as a government policy goal should be looked at with caution, as this revival might prove to be short-lived if Japanese society seeks to achieve 'gender equality' (as an outcome), rather than 'equal participation' (as a process). "Now that major co-ed universities such as Hokkaido, Tohoku, Tokyo, Kyoto, Kyushu, Waseda and Tokyo Institute of Technology all demonstrate interest in attracting girls into their science and engineering departments, embracing the idea of supporting female scientists and meeting the targets set by government, the real test for women's universities has begun" (J-2). The 'equality' principle could challenge and destabilize the basis of women's universities, just as it did for their counterparts in England.

The next section examines whether people in the position of fostering female scientists in the two countries share the view that women's colleges have fulfilled their missions, in particular in the field of SET.

Mission completed? Perspectives of those fostering female scientists in England and Japan

As previously noted, women's universities are perceived differently by the general public in the two countries. For a much longer period of time, gender segregation in education was justified in Japan under the ideal of women's primary roles as 'good wives, wise mothers'. Within this context, women's universities in Japan have been given a special protection from fierce competition with co-ed universities, and provided in return an environment free from gender biases, particularly in science education. However, it is worth noting that their good reputations have been secured on the ground, that women's universities are 'family-friendly' institutions. They are neither radical nor feminist in any way. In England, on the other hand, progress in gender equality was made at a much faster pace in society, which challenged the *raison d'être* of women's colleges at Oxford and Cambridge. Their radical pasts and progressive approaches can be divisive for those within and without. In particular, students who choose non-traditional subjects for women, such as physics, mathematics and chemistry, appreciate the supportive environment of their colleges (Miller-Bernal 2006: 361). However, competing for better students with other colleges within the same university at Cambridge puts constant pressure on women's colleges and exposes their academic performance to public scrutiny.

Despite these stark differences in their images and reputations in society, none of those engaged in fostering female scientists thought that women-only institutions had had their day. This may not be so surprising given that most respondents are at the 'coal face' of science education for women or administration of women's colleges. However, there are some remarkable differences in the nuance and tone of how they expressed their support for women's colleges in the two countries, and it is worth highlighting them.

First, what most people in both countries agreed on was the importance of securing an environment where girls can learn to take the leadership in a group without relying on others, particularly their male counterparts.

'Studying at women's universities means that gaining confidence and skills to learning leadership as an individual, free from the sense of "womanliness"' (J-3). 'Depending on the personality, family background and cultural traditions, some girls, not all, need an encouraging environment in order to develop their skills, particularly when they are interested in non-traditional SET subjects' (E-2). Making a more explicit link between science education and women's colleges, some stated that 'women-only institutions allow women to develop without comparing themselves (consciously or not) with men, or to consider themselves as doing something that is "odd".' (E-3) and '(w)omen-only institutions can provide an environment in which women can learn their subject without having to adapt to male-oriented thinking and with more freedom to fail. At least in the UK and the US a man's failure is seen as a consequence of his stretching himself while a women's failure can be seen as confirming female incompetence'. (E-4) Although similar views were expressed in Japan, the respondents in England were much more vocal on this point.

Second, an abundance of role models was also mentioned by many interviewees in both countries as the key resource that women's colleges have.

'Women-only colleges have produced many brilliant alumnae who are active in many different disciplines and also internationally successful. They act as role models for the students here' (E-5). 'Role models are meaningful and empowering only when they are in direct and regular contact with followers' (E-1). 'Compared to co-educational institutions, at women's universities, more women are involved in the decision-making process of university and also have higher positions, which are visible to their students. They are role models, and there is more collegiality amongst them' (J-4). Yet one interviewee quietly admitted the difficulty of becoming a female role model in Japan, particularly if the person is single or without children. A couple of interviewees mentioned a 'family' influence over girls' choices of non-SET subjects as an obstacle in Japan on top of the more universal problems of career breaks (e.g. maternity leave) for working mothers. 'There is still a strong sense in society that "girls do humanities, boys choose sciences"' (J-5). 'Parents normally disapprove when their daughter expresses her interest in specializing in science or engineering. They may think that natural science is "difficult, dirty and dangerous" for women' (J-6). These comments partially answer the question, 'why aren't more women in SET?' (Kuwahara 2001; Ceci and Williams 2007), pointing out the persistent nature of social imagery. In England, the situation is slightly more advanced, with some subjects (e.g. biology) being popular among girls. One interviewee touched on the gap in popularity amongst SET subjects by noting that 'it is clear in the UK that cultural factors are very important. At undergraduate level women are 60% of those studying biological sciences, 42% of those studying physical sciences and 15% of those studying engineering and technology. Since job prospects and support in terms of maternity leave etc are similar for the disciplines, it appears that cultural factors strongly affect girls' choice of subject'. (E-4) Given the different rates of progress in England and Japan, presence of role models close at hand at women's universities may have a larger significance in Japan than in the UK, not only assuaging parents' apprehension for their daughters' futures but also positively changing the stereotypes attached to female scientists in the wider society.

Overall, there was a general consensus among the interviewees that women-only institutions still have a role to play in science education in both countries, as nobody rejected it outright. However, there were varying degrees of acceptance. Several claimed that there was no need for such institutions unless 'they are well-resourced and run by staff who teach using gender-inclusive techniques and are interested to promote women's achievement in non-traditional roles' (E-6). 'In modern society, women also began to demonstrate leadership even in co-educational institutions. So that (i.e. providing an environment for women to do so) should not be the only reason for the existence of women's universities' (J-4). Others worry that graduates from women-only institutions may be treated as second-class scientists once they graduate. One conceded that 'I think women only colleges in some societies still have a role to provide an environment which nurtures confidence and mutual support at an early career stage, providing there are opportunities for greater mobility between institutions such that women can develop their career then can aim to move on to mixed universities if they wish' (E-7). 'Although I think there are still roles for women only institutions, including secondary and tertiary education, it is essential that they are not closed enclave-like institutions' (J-5). Some answers imply that their support for women's universities is conditional and for them, they are a temporary measure for certain societies at a certain stage of development. 'These institutions must be seen as prestigious places to go and they may in time, become co-educational when female scientists and engineers have achieved critical mass in Japan' (E-6). Some voiced concern that women's universities could be the only major forum for networking. 'Women scientists need to organize themselves with a network to support each other and to have a stronger collective voice to campaign against perceived prejudices.' (E-7). 'Rather than the mere existence of such institutions, perhaps it is more important for colleges to understand and accommodate the different learning styles and motivators which exist not just between genders but from person to person'. (E-3) Although these critical views were mainly heard in England, some in Japan adopted a *laissez-faire* approach to the future of women's universities. 'As long as women's universities produce excellent scientists, the good tradition should be maintained' (J-6). 'Let students decide whether they still need such institutions through their admission process' (J-8).

Finally, directors of women's universities in both countries advocated their missions in society, both at national and international levels. At the national level, they argued that women-only institutions should remain one option for certain types of women for a truly equal and diverse society (E-2/J-4). Interestingly, in Japan, two directors had contrasting stances towards their roles. One remarked 'given the extremely low score on GEM, our university has a rather large mission to carry out nationally' (J-1), while another argued that their mission of fostering a 'good wife, wise mother' should be reinforced (J-9). At the international level, women's colleges at Cambridge still provide a popular choice for foreign students and their parents whose cultural traditions favor single-sex education. 'Offering this choice for foreign students is very important in an increasingly more competitive climate in global education market' (E-5). She also emphasized international collaboration with other women's universities across the Atlantic. Another director commented that 'it is time women universities mobilized their knowledge and experience from the past to support education for women in developing countries' (J-3). Although they may be making strategic choices for their survival, the changing focus in their missions is worth underlining. Women's universities and colleges still have a role to play, but with varying degrees of importance depending on the social acceptance of diversity and individuality over gender differences.

As previously mentioned, the dataset from the interviews and questionnaires may not be sufficient for identifying whether respondents' beliefs were shaped by their positions or cultural backgrounds. The article has its limits in examining the gender gap concerning the support for women's colleges, due to the very small sample. However, the differences in the nuance and tone of expression between the two countries' respondents confirmed that in England some fear that women's colleges could now be seen as 'closed' and 'second-class' institutions, whereas in Japan, the 'good tradition' and family-friendliness are very much considered to be an asset. In this sense, the responses echoed the views expressed in the print media in both countries. Yet what the data also clearly show is that there is a challenge ahead for women-only institutions, even in Japan, as greater emphasis is placed on making individual choices and making the best use of everyone's talents rather than collective choices based on socially accepted gender roles.

Conclusion: Challenges for both worlds

The goal of fostering women in science and engineering appears to be faced with a universal dilemma, i.e. the public perception that men are better at those subjects. Examining the policy developments in the two countries considered here (England and Japan), and the quite different roles that women's universities began to play in the government-funded schemes of each, has underscored the significance of dominant discourses determined by national contexts. The equality discourse was much more pronounced in the UK, which worked against the survival of women's colleges, whereas the family discourse in Japan recast the role of women's colleges in both fostering the next generation of women scientists for the country and in supporting working mothers in SET. Although the reality surrounding female scientists in the two countries (e.g. need for childcare facilities) is similar, the primary actors for bringing about needed changes are different. As the case of England has demonstrated, the government, academic community, local authorities, voluntary networks and the business sector all play their parts in the campaign. In Japan, although the academic community also actively advocates the retention of female scientists, the major actors are universities and corporations. The role of women's universities was legitimized by the government's decision to invest in their projects to foster female scientists in already established family-friendly institutions.

Rather contradictorily, the slogan, "equal participation for men and women" has promoted women's universities in Japan, while the corresponding "equality and diversity" in the UK leaves little scope for women's colleges to legitimize their purposes. This is partly because of the history of women's universities, and their reputations as excellent institutions for producing skills and knowledge including mannerisms, which are useful for both society and the market in Japan. The country is now

faced with double imperatives: the need for researchers in SET subjects (both men and women) to drive technical innovation for the economy, and for mothers to raise the future generation so as to turn the tide of the rapidly graying population. In this sense, women's universities have always been advocating the family discourse (i.e. equal participation of men and women), rather than promoting pure equality and the feminist cause. On the other hand, several interviewees in England emphasized that what the campaigns for women in science need is men's involvement (E-2/E-7). In order to get them on board, women's colleges, seen as 'women-only' places, often require other arenas, such as academic or local communities where men gather. The questions facing women's universities in Japan are: how long will their positive image last, and what will happen when they accomplish their primary goal of producing more female scientists? There is already fierce competition among universities to recruit more girls in the coming era of a rapidly declining young population. Accordingly, co-educational institutions continue to vigorously publicize their interest in fostering female scientists. Therefore, beyond the rhetoric, the realities in both countries pose different, but great challenges in responding to the same questions concerning gender equality in science from their respective socio-economic perspectives. How policy ideas are formulated in response in each case, and how they are underpinned by their wider institutional settings, is still crucial. Ultimately, it is how local agents make sense of these ideas that will provide the key to understanding these societies in transition.

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List of interviewees/questionnaire respondents

	Coded name	Function
England	E-1	Tutor (physics) at women's college
	E-2	Fellow (life sciences) at women's college
	E-3	Researcher, SET Women, mentor coordinator
	E-4	Advisor for WiSETI at the University of Cambridge
	E-5	Director of women's college
	E-6	Senior lecturer (science education), SET Women
	E-7	Coordinator, CamAWiSE
Japan	J-1	Director of women's university
	J-2	Professor (physics) at women's university
	J-3	Director of women's university
	J-4	Director of women's university
	J-5	Director, Female Researcher Support Centre at former national university
	J-6	Deputy Director, Female Researcher Support Programme at women's university
	J-7	Director, government agency (science and technology)
	J-8	Director of women's university