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# Group work experiences of women students in a Scottish chemical engineering programme

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## ABSTRACT

Chemical Engineering, similar to other Engineering courses, has seen an undergraduate gender shift in recent years towards greater women student representation. This raises the issue of the inclusion, in terms of equality of participation and opportunities, of these women students in learning activities and also the role that they can play in encouraging inclusion and development of others, which can have implications, not only for their current studies, but their future careers. This paper provides both statistical evaluation of students' attainment from group working activities, and a narrative account of the students' experiences along with the resulting impact on their inclusion, engagement and group interactions. We highlight the changing role filled by women students and their awareness of these changes and impacts. Notably, the work identifies a change in attitude with regards to roles for women in facilitating group work with many women students purposefully avoiding the additional work-load that past studies have identified.

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## 1. Introduction

Similar to other engineering courses, Chemical and Process Engineering at the University of Strathclyde has seen an environmental shift in recent years towards a balance in gender population. While a completely balanced population does not exist at present, there has been a significant move towards more equal balance from the heavily men-dominated composition at the start of the millennium. There is a growing interest in diversity, both as a result of the growing number of minority personnel (including women) within the workplace (Buhler, 1997) and the move for organisations to utilise the varied skill sets and backgrounds offered by their workforce (Dean and Snell, 1991). Researchers have previously found gender diversity to produce a variety of effects on group performance, including reduced cognitive task performance as a result of gender heterogeneity (Kent and McGrath, 1969;

Murnighan and Conlon, 1991), improved same-gender support (Ely, 1994) and impaired men–women support (South et al., 1982). Conversely other researchers have reported no such effects (Pelled et al., 1999). As a result of the gender shift in the Department, this paper aims to fill a gap in the literature, by providing an account of the experience of women students within group activities, in an environment that was previously almost exclusively men. These activities are designed to develop group working skills and to foster inclusion of all students, which is important for women engineers due to demands that industry has set for its graduate level employees (Confederation of British Industry, 2012).

The role of women in team activities has been evaluated as cooperative, as opposed to the competitive nature associated with men students: this has, in turn, suggested that women students are more suited to collaborative working than their male colleagues (Gilligan, 1982; Belenky, 1986). Despite

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their natural cooperation in group situations, it has also been reported that women students often face negative attitudes from their men peers (Flynn et al., 1991; Carter and Kirkup, 1990), and may be allocated group roles, such as secretarial tasks, based on gender related assumptions. It is notable and encouraging, however, that University teaching staff have been reported to offer fair treatment to all students regardless of gender (Flynn et al., 1991; Carter and Kirkup, 1990). The assignment of office based tasks may result from women students' inherent feelings towards contributing to the nurturing and people oriented areas of group dynamics (Flynn et al., 1991). It has also been postulated that such submissive behaviour may be related to the established but, more importantly, latent male dominance evoked by the cultural system of reproduction (Cocks, 2012) or instilled definition of role via gender associated parental bonding (Chodorow, 1989). Studies have suggested a move towards androgynous group working, allowing some socialised reversal of established roles, whereby men students may, for example, demonstrate a more nurturing character (Lay, 1989); supported to some degree by a proposal for the wider acceptance of men to adopt more woman-like characteristics, again to develop their nurturing side (Chodorow, 1989). One criticism of such changes in stereotypical behaviour is that 'female' characteristics may cause, as well as resolve, conflict in a team, by making individuals less assertive, easily dominated by 'male' colleagues or against 'female' authority as a result of interpersonal conflict with women leaders (Flynn et al., 1991).

A question that has been extensively investigated in the literature is the issue of proportional representation in group activities: while some have argued that increased gender representation should not only increase interactions between men and women (Blau, 1977), but also reduce stereotypical role assignment (Kanter, 1993), and the overlap of sexual and workplace roles (Guttek, 1985), hence removing barriers to inclusion (Larkey, 1996), others have argued that increasing the minority threatens status of the majority (Blalock, 1957). In addition, there are conflicting reports of negative (Spangler et al., 1978; Izraeli, 1983) and positive (South et al., 1982; Toren and Kraus, 1987) outcomes for numerical minorities within group work, and gender-heterogeneous groups have been shown to perform both better (Hoffman and Maier, 1961; Wood, 1987) and worse (Kent and McGrath, 1969; Murnighan and Conlon, 1991) than gender-homogenous groups, suggesting that the issue is heavily subjective. Hence, the study undertaken here does not seek to balance gender within groupings, which would not be possible for all groups due to the under-representation of women students in the total cohort. Rather, the Department adopts a random allocation of students to groups, to more accurately simulate the potential working environments faced by students whilst also offering insight into the effects of women representation on academic attainment.

It is important, in light of the collaborative working environment expected, not only in chemical engineering, but also the wider industrial sector, that students are able to integrate into teams and work collaboratively with colleagues, as and when required. Hence, the principal aim, over all degree streams and years of study, is to foster inclusion of all students to achieve their maximum potential, which can be an issue for the integration of minority groups, such as women students. It is worth considering inclusion within education as a broad and complex issue, impacting more than a single group of learners, providing 'equal opportunities for all pupils,

whatever their age, gender, ethnicity, attainment and background' (Office for Standards in Education, 2000).

Previous studies into the development of science and engineering first year women undergraduates have focussed on the social aspects of their inclusion and experience, including socialisation practices based on gender (Clewell and Campbell, 2002; Fennema et al., 1998; Trentacosta and Kenney, 1997), the impact of negative interactions with peers and University staff (Ong, 2001; Leslie et al., 1998; Seymour, 2000), and dissuasion of continuation by stereotyping (Ong, 2005; Steele, 1997). Chemical engineering teaching often uses group work to simulate the real-life working environment that students will encounter upon graduation, and previous research indicates that such practices can enhance student learning (Brereton et al., 1995; Lave and Wenger, 1991) by providing students with exposure to the same methods that they will employ in the workplace (Heitmann, 1996; Dewey, 2013). However, studies on team diversity have generally focussed on functional and educational diversity (Choi, 2007; Fay et al., 2006; Shin and Zhou, 2003; Somech, 2006) rather than specifically on gender. Knowing that an isolated individual's behaviour is very different to their behaviour in a group situation (Zajonc, 1965), and that women students, especially those from minority backgrounds, have been previously cited as preferring to work in teams (Brown, 1995), the programme studied at Strathclyde promotes group work and integration as a means to enhance both learning and employability.

This paper aims to build on a solid foundation of earlier research, most notably the contributions of Walker, who argued that, 'women's and men's experiences are bound into the construction of their engineering identities through relations with others and under particular social and individual conditions of (gendered) possibility' (Walker, 2001). Students continue to be bound in the construction of these identities, but the social and individual conditions have changed. This paper explores the impact of group activities on student attainment and reports students' experiences (both men and women) of diverse group working. It highlights a shift in the role many women engineering students occupy within this educational domain.

## 2. Research methods

### 2.1. Ethical considerations

Before the study began all students were given a description of the study and a Participant Information Sheet. Students were provided with a consent form and the opportunity to address any questions about the study. Following completion of the consent form, a questionnaire was used to gather basic socio-demographic information. Students had the ability to remove themselves and their data from the study at any point. In the discursive sections below, pseudonyms have been used.

### 2.2. Composition of the study

The student population sampled was composed of 120 first year students aged 16 to 18 years old and enrolled on either a 4 year BEng in Chemical Engineering, 5 year MEng in Chemical Engineering, or 5 year MSci in Applied Chemistry and Chemical Engineering. These students all entered their degree programmes at the University of Strathclyde in the autumn of 2012, and the population of 120 represents the full cohort for

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