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Towards Unifying Gender Disparity/Gap in STM: The Roles of 'CAT' and 'SEIT' in Enhancing the Career Interest of Female and Women in Male Dominated Studies/Occupations

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Abstract

This study describes gender differences in student achievement in the academic areas of science, mathematics and technology (SMT). The literature indicates consistent patterns of gender differences in SMT in which males generally performed better than their female counterpart. The study suggests, career awareness training and self-efficacy intervention techniques in enhancing the career interest of female students in male dominated subjects or occupations and the conditions for enhancing female's career

interest in male dominated subjects/disciplines should be incorporated into the SMT curriculum.

Key words: Gender, STM, CAT, SEIT and Self-efficacy.

Gender differences in mathematical abilities have become of wide interest to researchers in the recent past. Females seem to outperform males on computational tasks and do less well on problem solving (Cleary & Hengkietisak, 1989). Two recent meta-analyses of visual spatial skills indicate that males outperform females on spatial tasks (Linn & Petersen, 1985; Druva-Roush & Wu, 1989).

Since the publication of Maccoby and Jacklin's 1974 book, The Psychology of Sex Differences, it has been generally accepted that differences between males and females do exist with respect to measured verbal and quantitative abilities. There is no doubt that women are under represented in so many facets of life; and in fact the focus of attention in vocational psychology and career counseling today has to do with gender differences in career choices (Gati, Osipow and Givon 1995; Farmer, Rotella, Anderson and Wardrop, 1998; Dex, 1985; Goldin, 1990; Oyedeji, 1996; Bojuwoye and Imoukhome, 1986; Brosman, 1998). As observed by Gati, et al (1990) women tend to be engaged in small range of occupation that are traditional, female sex stereotyped and in the lower occupational level where salary levels are usually relatively low. This opinion probably explains women's underprivileged position in the society, and hence the formulation and implementation of policies and programmes, however, it has been observed that women's career choices have remain traditional and feminine-oriented (see Misler, 1975; Nevill & Schlecher, 1988). Both Osipow (1983) and Gati, et al (1995) agreed that the differences are meaningful and deserve further theoretical attention.

The research literature contains myriads of sources of such work-related gender differences. Demographic variables, e.g. age, socio-economic status (SES), race, gender and ability have been found to be an important source (see Farmer, Wardrop, Anderson & Risinger, 1995). Cognitive sets which include career aspiration levels and self-perceptions about role commitments, an independent self-concept and self-efficacy also offer some explanations for the differences. Several studies conducted in the recent times (Adeyemo, 1996; Hackett and Betz, 1981; Lent, Brown and Larkin 1984) have provided sufficient evidence for the existence of relationship between self-efficacy and

career behaviours in one hand and differences in the self-efficacy beliefs of men and women.

Behaviour variables have also been found to account for the difference in the work related behaviour of men and women. The behaviour set included the number of elective Maths and Science courses the subjects had taken in high school (Farmer, et al 1995). Achievements in Mathematics and Sciences have been identified as one of the several reasons hindering women labour force participation and under-representation in male dominated occupations (Eden, 1992; Oyedeji (1996); Chacko, (1981); National Science Foundation (NSF) and Shuard Science, Maths and Technology (SMT) occupations).

Environmental variables such as supports from parents (Parental Support), school (school support), society (society support) and finance (financial support) were identified by Farmer, et al (1995) to exert significant influence on women career choices.

Having done a comprehensive review of literature on the career psychology or women, Betz and Fitzgenald (1987) proposed four set of factors facilitative of career development of women: (a) individual variables (high ability, liberated sex role values, instrumentality, androgyny, high self-esteem, strong academic self-concept); (b) background variables (working mother, supportive father, highly educated parents, female role model, work experience as an adolescents, androgynous upbringing); (c) educational variables (higher education continuation in mathematics, women's school); and (d) adult-life style variables (late marriage or single, no or few children).

Rotberg, Brown and Ware (1987) studying community college students found that expressed interest and self-efficacy each predicted range of occupational consideration and that sex role orientation was related to socio-economic perception; self efficacy has been found to be related to inventory vocational interest. Lent, Brown and Larkin (1989) found significant relation of SE to corresponding technical scientific interest scales on the Stron-Campbell Interest Inventory (SCII) and, Lapan, et al (1989), employing path analysis indicated that Maths SE beliefs and high school preparation mediated gender differences in investigative and realistic themes on the SCII.

In conclusion, it is clearly evident from the literature reviewed that: (i) women are under represented in science, mathematics and technology occupations; (ii) several factors combined together to hinder women labour

of force participation; (iii) low self-efficacy and interest of women in male dominated occupation featured prominently among the factors.

The purpose of this study was to suggest use of career awareness training (CAT) and self-efficacy intervention technique to enhance the vocational interest of female and women in male dominated occupations.

Gender Differences and Career Choices

The discrepancy between male and female performance in mathematics has been a major issue in the literature (Dweck, 1986). Though evidence usually supports that the discrepancy, if any, is not large (Pajares & Kranzler, 1995), it is apparent that girls do not choose mathematics courses in their secondary and tertiary education as often as boys do. There is a further obvious difference in carrier choices as well; for example, women are underrepresented in math-related occupations, such as engineering and the natural sciences compared to men.

Research in motivation suggests that sex differences in attitudes towards mathematics are noticeable in high school (Wigfield, Eccles, & Pintrich, 1996) and that motivational patterns and associated behavior appear to be larger among the brightest students (Dweck, 1986), with girls displaying shakier expectancies and lower persistence in the face of failure or confusion. Fennema and Sherman's work (1978) on gender differences pointed to the critical role of affective variables. Bussey and Bandura (1999) emphasized the influence of sociostructural factors that operate through biological potentialities in shaping human behavior. Stereotypes that exist in the society, whether in the family, the classroom, the peer-group, the school, the mass media, or the culture in general, undermine girls' sense of efficacy in school mathematics. In the framework of social-cognitive theory, self-efficacy is hypothesized to mediate gender differences in mathematics performance and attitudes towards the subject.

In beginning middle-school students, Pajares and Graham (1999) did not find any gender differences in self-efficacy beliefs. Pajares and Kranzler (1995) did not report any significant gender differences in high-school mathematics performance (only close to significance), or mathematics self-efficacy, however they are not very confident in their claims because of the small sample size of their study. They did find differences in anxiety, which was strongly influenced by efficacy beliefs. Pajares and Miller (1994) found gender differences in mathematics problem solving performance in favor of

males at the university level. In generals, males reported higher mathematics self-efficacy, while females expressed higher anxiety levels. Girls made lower judgments of their capabilities and this explained for the most part their poorer performance. Path analysis showed that differences in performance were due to differences in perceived self-efficacy.

Gender differences exist in choices with regard to the college majors and careers, and particularly in science fields that require quantitative and technical background. Efficacy beliefs are considered to play a mediating role between gender and career choice, as in the case of performance in school mathematics. Individuals with a strong sense of self efficacy tend to consider a wider range of potential careers, prepare better for different careers, and stay longer in the field they have chosen (Lent, Brown & Kackett, 1994). Hackett and Betz (1989) used the Mathematics Self-Efficacy Scale to study major choice. They pointed out that undergraduate students' beliefs on mathematics self-efficacy were highly predictive of their choice of major after controlling for mathematics aptitude and anxiety. Women's lower sense of self-efficacy for math-related courses has been found to influence the subsequent choice of their career (Betz & Hackett, 1983; Hackett, 1985; Hackett & Campbell, 1987). In predicting interest to pursue a career in science and engineering, O'Brien, Kopala, and Martinez-Pons (1999) found direct effects of gender and self-efficacy, which was further predicted by prior achievement and ethnic identity.

Many researchers have investigated attitudes by studying variables or by examining its relation to a specific aim such as achievement (Albert, Aschenbrenner, & Schamolhover, 1989). Researches in science and SMTeducation show that gender and academic major can affect attitudes toward science and SMT. Many researchers found that boys exhibited significantly more positive attitudes toward science and SMTthan girls such as Lowery, Browyer and Padilla (1980), Baker (1983), Simpson and Oliver (1985), Pogge (1986), Oliver and Simpson (1990), Eryilmaz, (1992); Ozyurek and Eryilmaz (2001). Some researcher such as Maple & Stage, (1991) and Archer & McDonald, (1991) revealed that females had avoidance of additional science courses. Schibeci (1984) stated that females exhibit more positive attitudes toward biology and males towards physics. The American Association of University Women-AAUW (1992) data shows the need to focus more attention on the development of positive attitudes towards science with females. The females become less confident of their academic skills as they progress through secondary grades, therefore, their career

aspirations are narrowed (AAUW, 1992; Linn & Hyde, 1989). National Science Foundation data (NSF, 1994) shows that females consist 46% of the labor force with only 22% of the scientists being female. Besides this, Barrington and Hendricks (1988) have concluded that there was no gender difference with respect to attitudes toward science.

It is known that self-competence level plays important role in attitudes toward SMT. A positive correlation was found between gender and attitude towards SMTby Morgil and Seçken (2004). They have also found that self-efficacy belief of male student teachers was higher than female ones supporting the similar studies made by Betz & Hackett (1981), Jones & Wheatley (1990), Brophy (1985) and Aşkar & Donmez (2006). Smithers and Robinson (1988) also have found a declining interest in SMTfor young people. There is a widespread scientific ignorance in general populace according to Durant and Bauer (1997); Durant, Evans, and Thomas (1989); Miller, Pardo, and Niwa (1997). On the other hand, House of Lords (2000); Jenkins (1994) and Lepkowska (1996) stated that an increasing recognition of the significance and economic utility of scientific information and its cultural background has become a matter of social concern and debate. In addition, the concept of attitudes toward SMTis often poorly investigated and not understood well.

University teachers usually mention characteristics like attitude, drive, and actual interest that are the most important student characteristics associated with successful studies. Likewise, questions about the importance of attitude (Dalgety et al., 2003), and of motivation (Covington, 2000) have been investigated by many educational researchers.

There are many factors affecting attitudes toward SMT. Gender differences and academic major are some of these factors. The teaching programs should be prepared according to the factors affecting toward SMT.

Enhancing Vocational Interest

Although, there are several ways of enhancing vocational behaviours, the present study, employed career awareness training and self-efficacy techniques to accomplish its goal.

The career awareness training programme is heavily drawn on the Parsonian model of career counselling (Parson, 1909). The model involves basically, self analysis and job analysis self-awareness as indicated by Kush and Cochran (1993), not only has the advantage of helping client to consider their

strengths and weaknesses, this phase of career counselling typically attempt to clarify interests, values, and ambitions or in short, meaningful basis for career striving. During the job awareness phase, a person is making effort to translate personal meaning into viable options and goals. The approach also inspires confidence in the possibility of actualising meaning in career.

The self-awareness exercise involves helping subject to have a comprehensive "knowledge about self (Gesinde, 1986). This can be done through answers to the following questions.

(a) Do you want a long or short term involvement in this occupation?

(b) Do you have the personality wherewithal to cope with the demands of the job?

(c) Do you have sufficient likeness for the work environment?

(d) Will the opportunity structured be commensurate with your expectations?

(e) Do you want a job that would be fixed or involved transfer?

(f) Are the subjects you doing relevant to your career choice?

(g) Is your academic performance good enough to qualify you for a career in science, maths and technology occupations (SMT)?

(h) Are your parents rich enough to bear the cost of training?

The self-awareness exercise apart from generation personal critical for matching self and occupation, also helps to crystalise meaningful motive.

The job awareness exercises enable a person to collect reliable and recent information about the career on which informed decision can be made. The person needs to know:

(a) The past, present and the future status of the job or profession.

(b) Information about the cost of training;

(c) The nature of the work performed in the occupation;

(d) Information about the work requirements;

(e) Information about the entry requirements;

(f) Information about the people who are already in the profession;

(g) Information about the reward pattern in the job;

(h) If the job has prestige; and

(i) Biographical and personality requirements of the job.

The career awareness training is hinged on the belief that information about self and the career can be used to increase young people's awareness of the occupational world and stimulate and or enhance their interest in exploring it. Commenting on the use of information in career counselling, Hayes and Hopson (1987) said that occupational information can be used to stimulate basic vocational thinking and to motivate the individual to take an active part in making vocational decisions. Thus, it is expected that by exposing students to information relating to their personality and career opportunity in SMT occupations, they would be able to develop appropriate interest in male dominated occupations and go ahead to make career in it.

Self-Efficacy Intervention Technique

The self-efficacy intervention programme has its theoretical base in Badura's (1986) social cognitive theory. As conceived by social cognitive theorists, self efficacy is concerned with the people's judgement of their capabilities to organize and execute courses of action required to attain designated type of performance (Badura, 1986: p. 391), strongly influence the choices people make, the effort they expend, the strength of their perseverance in the face of adversity and the degree of anxiety they experience. Convergent research has concentrated on the role of self efficacy in motivating job performance (Eden & Zuk, 1995; Gist & Mitchel, 1992; Lock and Latham, 1990). Previous research had proved the efficacy of self-efficacy intervention in performing an industrial, clearical or sales job or an air traffic control task; improving attendance at work; completing a doctorate, conducting a job search, volunteering for elite, improving career decision making, (e.g. Caplan, Vinokur, Prince & Van Ryn, 1989; Chapman and McCanley, 1993; Eden & Kinnar, 1991; Eyrying, Johnson & Francis, 1993; Frye & Lathan, 1987; Gist, Schwoever & Rosen, 1989; Sutton & Woodman, 1989; Dawes, Harran, Hackett, 1997). The purpose of this work was to evaluate experimentally, the effectiveness of career awareness training and self-efficacy intervention techniques on the career interest of adolescent women in male dominated occupations.

To facilitate subjects' career interest, the researcher employed and developed intervention programme based on two of the sources of self-efficacy information defined by Badura (1986). The researcher employed a combination of verbal persuasion and modeling of successful women in male dominated careers to provide vicarious experience.

In using verbal persuasion, the experimental asked the subjects to fill the subject preference list. Each presenter presented her subjects to the class and gave reasons for the preference. They were to also indicate their career choices. As the presentations were made, the experimenter commented on the rationality of the combination as well as the subjects' congruency with the career preferences. Careers associated with each of the subjects were also emplored. Job opportunities and prestige were similarly considered.

The belief that certain occupations were for men was also demystified. They were made to understand that it was insulting to their personality to tell them that women cannot by physicians, engineers, architects, etc. it is also errorneous for anybody to say that men are more intelligent than women. There is no empirical basis for such claim. Such beliefs, they were told, were entrenched in religious and cultural system to keep women in perpetual subjugation.

In using modelling, students were asked to mention women in the SMT occupations. They were asked if they would like to emulate them and they answered affirmatively.

Following this exercise, prominent Nigerian women in the SMT occupations were presented to them in photographs. As each model was presented, their biodata were presented along with it.

In conclusion, the intervention programmes would be proved to be efficacious in enhancing the vocational interest of female/women in the identified male dominated occupations. This intervention clarified the development potentials that seem inherent in career motivation practice. Finally, it supports more systematic efforts at building conditions for enhancing vocational interest into career motivating programme.

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