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Examining the Impact of Formal and Informal Learning On the Creativity of Women Inventors

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Abstract. This research is about women inventors and how they feel education impacted their creativity. Data gathered strongly supports existing data which theorizes that "women's learning" (e.g. connected learning and relational learning) is different from men's. Creative women speak out about how they felt education impacted their creativity and what they would like to see education do to increase creativity and self-esteem in girls and women.

Research Methodology

Women inventors were chosen at random from a list obtained from the U.S. Patent Office. Nine hundred thirty (930) utility patents were granted to women in the year 1995. This represents approximately 8% of all patents. Three hundred women were randomly chosen and packets including an introductory letter, release forms, creativity test and demographics questionnaire were sent. Ultimately 37 packets were returned completed. These 37 women were again contacted and asked to continue with a personal interview addressing specifically, remembered episodes in their formal and informal educational experiences that helped or hindered their creativity? The interview would consist of their describing or telling two stories or experiences they had in education which they felt impacted their creativity. One story was from a formal educational experience and one story was to be from an informal learning experience. The term "impacted" was defined as "helped or hindered". Of the 37 women, thirteen agreed to continue with the indepth interview portion of the study. Specifically, the qualitative aspect of this study reported the thoughts, feelings and behaviors of 13 women inventors, in the context of formal and informal education.

Design of the study

The study was both quantitative and qualitative in nature. First a quantitative method was used to identify the level of creativity of the women inventors, specifically the *Brief Demonstrator - Torrance Tests of Creative Thinking (BD-TTCT)* which is a self-administered version of Torrance's test. It measures the four areas of fluency, flexibility, originality, and elaboration. Another important aspect of Torrance's tests of creative thinking is that studies have shown them to have no gender or age bias of any sort.

The second portion of the study was qualitative in nature and utilized an indepth behavioral event interviews (*BEI*). Thirteen of the original 37 women, who took the creativity test, volunteered to be interviewed. The women received a copy of what they would be asked so they could be thinking about their answers. They were asked to tell two true stories that happened to them. One about an *informal* educational experience and one about a *formal* educational experience which they felt impacted their creativity in some way. They were also asked what they felt education could do to increase creativity in girls and women.

Background of the Problem

For centuries men have considered women incapable of achieving creative success (Stanley, 1993). Creative works of women tend to be underrated or ignored in history (Showell & Amram, 1995). Even though women are making positive strides toward equality, it is possible that traditional educational practices have kept women from excelling in many areas (Ochse, 1991; Piirto, 1991).

Statement of the Problem

There is considerable empirical evidence which suggests that formal, as well as informal education, may neither have fully met the needs of women nor promoted creativity through the teaching/learning process. Further, there appears in the literature the realization that there is a lack of a deep understanding of how formal and informal education has impacted the creativity of women. This is problematic not only for reasons of gender equity but also because there is evidence that formal and informal education are not contributing to women being successful in the emerging postindustrial workplace and society.

Purpose of the Study

This study has two purposes. The first purpose is to ascertain, through a quantitative approach, the extent to which the *BD-TTCT* establishes that women inventors are in fact creative, as defined by Torrance (1965). It can be argued that women inventors are creative by the very nature of their having attained a patent. However, attaining *BD-TTCT* scores from women inventors will assist in providing insight into how their creativity compares to other populations where norm scores have been established.

The second purpose of this study is to develop a deeper understanding of how formal and informal education has impacted (ie. helped or hindered) the creativity of women inventors. Specifically, the qualitative aspect of this study will report the thoughts, feelings and behaviors of women inventors regarding the context of their formal and informal education.

A "*process*" definition of creativity . For the first quarter of the century creativity was studied only in the arts. Then in 1926 Wallas reported the first study of the creative *process* of an individual. A *process* is defined (by Webster) as "a series of actions or changes; a method of operation". By making a process out of it, creativity could be broken down into a series of steps, which could then be taught. In 1962, E. Paul Torrance published his first book on creativity as a process. In 1965 Torrance defined creativity in such a way that puts it into everyday living and did not reserve it for rarely achieved heights. His definition is the one used in this study. According to Torrance (1965),

Creativity is a process of sensing difficulties, problems, gaps in information, missing elements, something askew; making guesses and formulating hypothesis about these deficiencies; evaluating the testing these guesses and hypothesis; possibly revising and retesting them; and finally communicating the results (p.8).

Nearly all investigations of creativity in the literature have focused on the creativity of men. At best, generalizations based on male samples have been assumed to be applicable to females; at worst, creative functioning in women simply has been ignored altogether or eliminated from consideration. Historically it has been presumed that the creativity of women occurs with such insufficient frequency as to not be worth studying (Rieger, 1983).

History of women inventors. Great women, sometimes overcoming enormous social obstacles, have made contributions that have changed the world and continue to change our lives. In examining women in American history, we find women who have made vast contributions to society. American settlers had to be extremely inventive and creative to survive. The success of the colonies depended on the creativity of its settlers, both men and women. In the early 1700s women did work not generally thought of as feminine. They farmed, operated mills and learned trades. But as colonies grew, women's roles became more restricted (Stanley, 1993). Men formed governments based on the "old countries" in Europe while women were expected to center their activities on their husband and children. Once a woman had children, she was no longer viewed as a person in her own right. Therefore the history of women inventors is also the history of women's changing roles in society (Stanley, 1993).

As the social order of America became more established, it became more difficult for women who showed an interest in machines or other technology to be taken seriously (Stanley, 1993). Women were educated in the manners and morals of polite society and in the care of home and children while men studied science, technology and politics (Panabaker, 1991).

During the 1800s, most women's lives were filled with long hours of milking cows, churning butter, washing, cooking and cleaning. They also gave birth to children and raised them, and often worked in the fields. If a woman took time to invent something new, it was usually a way to ease her burdens (Panabaker, 1991).

In 1870, a woman named Margaret Knight invented a flat-bottomed paper bag folding machine. But Charles Annan, a man who had seen her models, beat her to the patent office. She filed a lawsuit against him claiming he had copied her idea. His defense against her was that she could not have invented the machine because a woman could not understand machinery. Fortunately, many people told the court they had seen or been involved with her in various phases of her work and she won her case and received one of the first patents granted to a woman (Macdonald, 1992).

Current status of gender equity in curriculum. In the late 1980's the American Association of University Women conducted a poll of 3,000 school children. The association's subsequent report *Shortchanging Girls, Shortchanging America* (1990), declared that girls face a pervasive bias against them from preschool through high school. The AAUW study *How Schools Shortchange Girls* (1995) further revealed that girls and boys are not treated equally in public schools and that they do not receive the same quality, or even quantity, of education. The key concerns for girls that surfaced in these two studies by the AAUW include: (1) low self-esteem, (2) low academic achievement, and (3) low aspirations and career goals.

Because of the curriculum used in education, the knowledge base, the examples seen in books and materials which are created by and are primarily about the white middle-class male experience, white middle-class males are more likely to be successful (Tisdell, 1993). The AAUW report of 1995 confirmed that one reason girls suffer from problems of low self-esteem, low academic achievement and low aspirations and career goals may be due to the curriculum.

Gender bias in our educational philosophy. Gender bias is occurring in education (Gilligan, 1993; AAUW, 1995). This means that education is not doing enough to ensure epistemological equity. Plato's account of the education of women is in Book V of *The Republic*, yet many texts and anthologies omit all references to Book V. Plato's proposal was for all who are suited to rule should, regardless of sex, be given the same education. These texts are either not mentioned or are distorted significantly (Pagano, 1994).

Another "father" of educational philosophy, Eric Erickson, admitted that his eight stages were for males when he said that the sequence is a bit different for women. A woman, according to Erickson, holds her identity in abeyance as she prepares to attract the man by whose name she will be known, by whose status she will be defined, the man who will rescue her from emptiness and loneliness by filling her inner space. Despite Erickson's observations of sex differences, his chart of life-cycle stages remains unchanged (Gilligan, 1994). Where are the "mothers" of educational philosophy?

Research Question #1. To what extent do women inventors demonstrate creativity as measured by the *Brief Demonstrator - Torrance Tests of Creative Thinking*? Eighty-five percent (85%) of the women in this study demonstrated above average to very high creativity. This suggests that women who hold utility patents are in fact creative and further validates the *BD-TTCT* as a useful instrument for identifying creative strengths of adults.

Research Question #2. How has formal and informal education been perceived by women inventors to have impacted their creativity?

Interviews were tape recorded, transcribed and coded by categories. Six categories emerged from the data and were listed in no particular order. These six categories fell into both formal and informal experiences, which both helped and hindered creativity. The six common categories were:

#1 - Learning experiences that contributed to these women's creativity tended to occur in unstructured environments regardless of whether the educational setting was formal or informal;

#2 - Learning experiences, both formal and informal, that contributed to these women's creativity tended to be hands-on experiences that were meaningful to their everyday lives;

#3 - Learning experiences that contributed to these women's creativity tended to be both cooperative and self-directed;

#4 - Learning experiences that contributed to these women's creativity tended to be facilitated by a nurturing teacher who role modeled creativity;

#5 - Women inventors had some definite ideas about how education could promote creativity and therefore increase self-esteem and improve the self-concept of women; and

#6 - Women inventors consistently indicated that gender discrimination hindered their creativity.

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Discussion

Gender equity must be consciously addressed. Gender equity must be consciously addressed, rather than dismissed as "there is no inequity in my classroom." All teachers do it. Even women teachers. We have had no other role-modeling. Teachers must strive to give equal time to women in class, to allow women to have experiential opportunities in which learning becomes relevant and relational, and allow for groupwork (Gilligan, 1993; 1994).

Learning environments favored by women are less structured. Adults have long been believed to be self-directed learners (Knowles, 1980; Merriam & Caffarella, 1991). On the other hand, women have been reported consistently in the literature as being cooperative learners (Belenky, Clinchy, Goldberger and Tarule 1986). Reports from the women in this study support both findings; they preferred to be self-directed and also preferred to work in cooperative environments. This can be accomplished in a less structured educational environment. A less structured environment allows for flexibility in which a person may work alone or may collaborate with others, as the need arises.

Learning environments are rarely totally structured or totally unstructured. Most learning environments fall somewhere along a continuum of structure. Teachers who make these decisions have some constraints, yet it is possible to make even a formal educational environment one which is less structured and conducive to exploration and discovery. It is the environment that is unstructured enough to allow for creativity in the classroom that the women, in this study, appreciated.

Research also shows that men can benefit from women's learning styles. Women's learning doesn't have to stifle or hinder men's learning in the classroom. Research has shown that cooperative and less structured learning environments, preferred by women, seem to be appropriate for men as well as women (Ochse, 1991). When men are exposed in the classroom setting, to the teaching styles preferred by women, they (the men) have shown no decrease in learning (Rosser, 1990; Ochse, 1991; Piirto, 1991) and have actually benefited from these practices (Ochse, 1991).

Nurturing teachers are important. Women in this study were unified in their belief that nurturing is a vital ingredient in women's learning. Stories, which referred to a teacher as very nurturing, indicated that the teacher had also been creative in their teaching. A teacher's care and nurturing was perceived as being a critical issue in stories of positive impact. Even if the woman had only one nurturing teacher, this one experience was perceived to have made a significant positive impact on her creativity.

Whether because of biological or sociological reasons, women seem to possess a unique power to nurture. This nurturing power can be used not only with loved ones and teaching our children, but also to build and lead teams in stressful everchanging work environments.

Women need to learn strong communication skills. We need to let others know our talents, abilities and accomplishments, by learning to powerfully communicate our ideas (Lerner-Robbins, 1996). Traditionally it has been the man who speaks, in church for instance. Women may have never had any opportunity to claim this power.

Issues of self-esteem. Many of the women in this study admitted to having low self-esteem. Those who brought the issue up said that education could do a lot to increase the self-esteem of young girls by treating them equally in the classroom. Not labeling or pigeon-holing women into pre-determined slots, simply by virtue of their gender, will do a lot for helping women to have a positive self-concept.

Conclusion

Women must be given equal opportunity in education. This means that educators must create opportunities that do not currently exist. Educators must teach creatively. A good curriculum guide for using creativity in education is *The Incubation Model of Teaching* (Torrance & Safter, 1990). The Incubation Model curriculum is not gender-biased (Goff, 1997).

Opportunities for women's learning typically do not exist in traditional university education. I have been a student for many years and I know of only one Adult Education class that used the Incubation Model. The class had more male than female students. This class was loved by all the students and got excellent evaluation comments such as "Best class I ever had" and "I learned so much in this class!" The professor, although qualified and available, was never asked to teach this class, or any other class for Adult Education, again. Obviously universities are set in their old ways. Most universities are traditional settings which focus on structured learning. This has been effective for males but has neglected, and continues to neglect female learners.

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