Why NOT Engineering –
Perspectives of Young Women and the Influence of the Media

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Overview

This pilot study is developed to assess how young women (10th grade girls) come to know the engineering profession. The study analyzes young women's career exploration approach and the influence that the engineering language and imagery has upon the young women as they explore the profession. The pilot study employs a qualitative research design and utilizes feminist theory to better understand the perspectives of the young women. The research methodology incorporates participatory action research whereby the young women participate in the design of the study (primarily the data collection methods). The researcher presents the findings using an ethnographic writing style in order to tell the story from the perspectives of the research participants. The contents of this paper include: definition of the problem, purpose of the study, research questions, preliminary research, research design and methods, and early findings.

At the time of this paper submission for the conference proceedings, this research is in progress. About one-third of the data has been collected. The remaining data will be collected in the upcoming month. As a result, the findings and preliminary analysis will be presented at the 2002 ASEE Annual Conference.

Introduction

The contributions of women to the engineering profession are vital, yet the interest level of young women considering the career field remains at unacceptably low levels. When looking at the supply of new workers — youth, in the case of this study — the career aspirations of high school students, and females in particular, do not meet workforce needs. Only 14% of a half million high school sophomores indicate an interest in engineering, and females comprise only 3% of the group (ACT Research, 1999).

The need to further develop a pipeline of interested and capable young women who will become tomorrow's engineers is widely acknowledged. A review of youth culture and modern-day

feminist research suggest a shift in adolescent perspectives and outlooks in regard to their professional ambitions and contributions to society (Schneider & Stevenson, 1999; The Lawlor Group, 2001 (August & September); Howe & Strauss, 2000; Tapscott, 1998; Teenage Research Unlimited, 2001). Behavioral science research also has made significant contributions to understanding the factors that work against young women when considering a non-traditional field like engineering (Young, 2000; Holland & Eisenhart, 1990; Eisenhart & Finkel, 1998; Gilligan, 1993; Belenky, Clinchy, Goldberger, & Tarule, 1997; Gilligan, Lyons, & Hanmer, 1990; Brown & Gilligan, 1990; Eccles, 1994; Seymour, 1997; Farmer, Anderson, Brock, 1991; Harmon 1989; Farmer, Wardrop, Anderson, & Risinger, 1995; Schaefers, Epperson, & Nauta, 1997). While this literature provides valuable insight to potential career decision-making factors, it does not investigate how young women come to know engineering by documenting their career exploration journey including an analysis of media influences (the language and imagery). This research attempts to construct and pilot research methodology in order to analyze and understand more fully how young women come to know engineering.

Purpose of the Study

The purpose of the study is to examine the influential factors that have an impact or effect young women when considering a non-traditional career field like engineering. Specifically, this study focuses on the career exploration process and the perceptions, a reflection of language and imagery, which constitutes young women's contextual understandings of the engineering profession. Topics the study will explore include:

- What are the ways in which meaning and perspectives are gendered?
- What meanings and perspective does engineering information create and convey?
- Is there correspondence and disjunct between the portrayal of engineering in college recruiting/career exploration communications and what is important to a young woman considering engineering as a career choice?
- What piques one's interest when researching careers or jobs? How do you get good information?

Methodology – Feminist and Career Development Theory

I will draw on two primary theories to inform this study, feminist theory and career development theory. Feminist theory is chosen because the origin of the theory is rooted in addressing a history of inequality and in developing the silenced voice for the purpose of social change (Denzin & Lincoln, 1998). Career development theory is intended to provide the reader with a reference framework relative to an adolescent's career exploration.

Feminist theory is selected to acknowledge the gendered dimension of analyzing the historically male profession of engineering. Sandra Harding (1986) writes about gender as an analytic category and tool "through which the division of social experience along gender lines tens to give men and women different conceptions of themselves, their activities and beliefs, and the work around them" (p. 31).

Feminist theory seeks to raise awareness of gender differences, and therefore alter the status quo. Feminist theory asks new and different questions. I believe that in order to appeal to young women and their ways of viewing the world and specifically, the engineering profession, it is necessary to employ feminist theory to develop and apply a different lens to better understand the viewpoints of modern young women.

Career development theory is utilized in this study because the study is about the process of exploring careers and making decisions about employment after high school. Vocational development researcher and author Donald Super (1990) claims adolescents explore or fantasize about careers simply because they seem glamorous and exciting. An initial phase in the career exploration experience for young people involves the deliberate process of researching career information. Often times this begins formally between the ages of 13-14 years of age when careers are introduced in civic or social studies curricula. This research will involve girls (ages 15-16) advancing through the initial stages of formal career exploration.

Research Design – Qualitative Tradition: Critical Ethnography and Participatory Action Research

The research design chosen for this study combines two qualitative research traditions — critical ethnography and participatory action research (PAR). The Greek root meaning of ethnography means to write about others (Erickson, 1986, p. 123). Critical ethnography takes on the additional task of raising the voice and level of consciousness on behalf of the research participants as a means of empowering them and giving research participants more authority (Thomas, 1993, p. 4).

Similarly, participatory action research became popularized by a research movement that was a partial solution for those traditionally oppressed (women and people of color), exploited, or abused in the research process (Denzin & Lincoln 1998, p. 335). As a result, the 'subjects' traditionally observed became active participants, to some degree or another, in the research design, data collection, and/or data analysis phases of the research. The participatory element which includes cooperation and collaboration between the researcher(s) and other participants in the definition of the research problem, choice of methods, data analysis, and the use of findings. Through participation, the research process is empowering and the knowledge is viewed as authentic.

The merits of this research approach should prove to be advantageous given the criticisms and failings of previous women's and youth studies that include claims that the research participants lacked voice. Current literature also suggest youth are especially critical and cynical of scholarly interpretation. Therefore, this study seeks to assure authenticity. The research design seeks to respect and honor voice through theoretical, design, and methodological frameworks. Via research design and methods, the research will provide "thick description" (Geertz, 1973) and tell an authentic story from the standpoint of the research participants.

Early Research

In the summer of 2000, I conducted a pilot study to begin to examine the phenomenon of young women selecting non-traditional career fields like engineering. For this pilot study, I chose two female participants who were predisposed to the idea of engineering as a career choice. These two soon-to-be-high school seniors had chosen to participate in a 6-week-long program sponsored by the program for Women in Science and Engineering (WiSE).

These two participants allowed me to identify what and who influenced them at that juncture in their career exploration journey. I expected young women who had chosen to attend a 6-week-long program for science and engineering exploration had formal and informal educational experiences in science, math, engineering, and technology (SMET), which would allow me to identify what and who had influenced their career development thinking.

What I learned from the pilot study was that these young women had limited knowledge about engineering, and they expressed difficulty when searching for information and answers about careers in engineering. They said the information, specifically learning about what engineering is and what engineers really do was hard to find. One girl described her understanding of engineering with imagery of long math problems and working in a cubicle with a computer and calculator.

They also told me their mother was the individual who provided them the most support and guidance through this journey; however, neither mother knew much about engineering, but did try to suggest sources for more information. As a result of these findings, the focus of my proposed study was narrowed to the career exploration process and examining how young women come to know engineering through language and imagery that, embodies the contextual understanding of the career field.

Participants and research site

When doing critical ethnography, the data sources — people, artifacts, or documents — serve to ultimately shape the analysis. It is important to select those who possess the "insider's knowledge" of the research domain (Yablonsky, 1969). To accomplish this, my study employs what Patton (1990) refers to a purposeful sampling and LeCompte and Preissle (1993) call "criterion-based" selection. Characteristics of purposeful sampling or criterion-based selection relate to the deliberate nature by which decisions regarding people, settings, and events are made.

The initial call for participation came from referrals by a program coordinator (SCIENCE BOUND — an after-school program for under-represented minority students entering 8th grade whose standardized test scores and/or teacher recommendations indicate ability), teachers and administrators. Two groups of four girls were identified. One group represented a small, rural school district and the other represented a large urban school. The groups were ethnically diverse. A second selection criterion filter involved a survey. The purpose of the survey was to identify girls who are:
   a) Beginning to think seriously about their future careers

b) Not pre-disposed to the engineering profession by a family member or family friend
c) Average to above average students (top half of their class and have a 2.8/4.0 grade point average).

In accord with participatory action research, the participants select the research site. This was their school, home, business, restaurant, and on the campus of the researcher. (The researcher has identified one research site - the Spring Engineering Career Expo held on the university campus.) Decisions as to whether the group would meet as a unit or as individual groups were decided using a participatory approach.

Information and decisions covered at the initial meeting with the research participants included (a) an introduction to research and research methodology, (b) discussion of participant and researcher roles, (c) sharing the objective of the research – to identify how girls explore and come to know engineering profession (what is seen, heard, and discovered), (d) brainstorming ideas and research methods and (e) planning data collection. Exploration was encouraged, however, a timeframe and general timeline was agreed upon.

Data Collection

At the Engineering Career Expo held on the researcher's university campus, all participants' tape-recorded their interviews with company representatives as well as their own personal comments and observations. To assure the participants are familiar with the purpose of the Expo and floor layout of event including the locations of the companies, background materials about the event were reviewed in advance. I served as their host throughout the event. Upon receipt of the Expo transcripts, the researcher conducted de-briefing sessions with the participants with the purpose of enhancing the data gathered at the Expo.

Following the Expo, the participant's expressed great interest in getting "more specific" information by visiting a company who attended the career fair to learn more about the profession 'on-site.' They specifically wanted to spend more "one-on-one time" with female engineers to learn more about what they do and to job shadow them for a day. A time was scheduled to carry out this task and data collection was discussed and planned.

As the researcher, I am writing an academic account of the research study. The research participants are writing in journals throughout the study. A reflection paper will also be written at the end of the study. The participants will determine if additional artifacts and documents should be included for data analysis. I will also use my observation notes, and the audio transcriptions in data analysis.

The Researcher

In qualitative research, researcher reflexivity is the backbone of the study and the methodology determines what perspectives will influence a researcher's assumptions about knowledge and how it is gained. To conduct this study, I will draw upon my 18 years of experience in the college recruitment profession. I find it interesting and enlightening to step back and learn more

about how young women understand their experiences, and how this affects their actions and activity in regard to career exploration and selection. Additionally, I have had a long-standing interest in women's issues, specifically the development of young girls, as well as an interest in technology and its social impact. Therefore, beginning to learn more about the influential factors that affect the ways girls think about their employment in technical fields is of great interest to me.

Data Analysis

Data will be transferred to a computer-assisted qualitative data analysis software (CAQDAS) – NVivo for coding and categorizing. The researcher will analyze the data preliminarily. Patterns and themes among the data are expected to emerge. This analysis will be shared with the research participants for further categorizing and theme development. Member checking, de-briefing, and theory generation will be conducted once the data are compiled and dispersed.

Rigor and Trustworthiness

Because ethnographic research can be considered "eclectic in its use of data collection and analysis procedures" (LeCompte & Preissle, 1993, p. 48), I will assure accuracy by employing five tactics that will serve to provide rigor and trustworthiness in the methodology and data.
  (1) I will exercise extreme caution when recording and analyzing data. To do this, I will have the transcripts from the meetings, activities, and de-briefing session transcribed by a professional transcriber. Since the primary consumer of these findings will be scientists and engineers accustom to empirical data and quantitative methodology, I plan to use computer-assisted qualitative data analysis software (CAQDAS) - NVivo. This software will store memos, code, link, search, retrieve, and display unstructured data that is in the form of extended text and transcripts from interviews.
  (2) I will employ four different data collection methodologies to assure accuracy, Denzin (1978) refers to this process of bringing together different sources of information and gathering techniques as "triangulation." Triangulation enhances the findings and safeguards against error in interpretation.
  (3) I will have two colleagues read drafts of the study. One individual is a vice president for a higher education marketing communications firm, and the other colleague is a university administrator and a female engineer. These individuals will assist in assuring researcher "reflexivity" – a term used by Hammersley and Atkinson (1983) to label the reality that the researcher is a part of the phenomena studied. Research reflexivity can be desirable and compliment the study, or, it can hinder the process if the researcher's role becomes controlling, biased, or some other undesirable influence.
  (4) When analyzing data, I will consult Carol Gilligan's study regarding male-based constructs and female experiences, specifically, the coding systems her Ph.D. students used when aggregating data across interviews.
  (5) Upon completion of the study, I will reflect upon the process and findings and make recommendations for further revisions or improvements to the study.

Early Findings

I have just completed the initial phase of data collection. I can provide some early findings the middle of next week 3/13.

Bibliography
References

ACT Research – Information Brief (1999, January). *Is the graduating class of 2000 prepared for jobs of the new millennium?* Retrieved June 8, 2000 from http://www.act.org/research/briefs/99-1.html

Belenky, M.F., Clinchy B. M., Goldberger N.R. & Tarule, J.M. (1997). *Women's ways of knowing: The development of self, voice, and mind* [revised ed.]. New York: Basicbooks.

Denzin, N.K. (1978). *Sociological methods: A sourcebook*. New York: McGraw-Hill.

Denzin, N.K., and Lincoln, Y.S. (1998). *The landscape of qualitative research – theories and issues*. Thousand Oaks, CA: Sage.

Eccles, J (1994). Understanding women's education and occupational choices: Applying the Eccles et al. model of achievement-related choices. *Psychology of Women Quarterly, 18*, 585-609.

Eisenhart, M.A. & Finkel, E. (1998). *Women's science.* Chicago: The University of Chicago Press.

Farmer H, Anderson, M., Brock, K. (1991), April). *Factors differentiating college science majors.* Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Farmer, H.S., Wardrop, J.L., Anderson, M.Z., & Risinger, R. (1995). Women's career choices: Focus on science, math, and technology career. *Journal of Counseling Psychology, 42,* 155-170.

Geertz, C. (1973). *The interpretation of cultures.* New York: BasicBooks.
Greenwood, D. J., & Levin, M. (1998). *Introduction to action research: Social research for social change.* Thousand Oaks, CA: Sage.

Gilligan, C., & Brown, L. (1990). *Meeting at the crossroads: The psychology of women and girls.* Cambridge, MA: Harvard University Press.

Gilligan, C., Lyons, N.P., & Hammer T.J. (1990). *Making connections: The relational worlds of adolescent girls at Emma Willard school* [Revised ed.]. Cambridge, MA: Harvard University Press.

Hammersley, M., & Atkinson, P. (1983). *Ethnography: Principles in practice*. London: Travistock.

Haraway, D. (1978). Animal Sociology and a Natural Economy of Body Politic, pts. 1 and 2. *Signs: Journal of Women in culture and Society* 4(no.1).

Harding, S. (1986*). The science question in feminism*. Ithaca, NY: Cornell University Press.

Holland, D. C. & Eisenhart, M. A. (1990). *Educated in romance.* Chicago: The University of Chicago Press.

Holland, J.L. (1985). *Making vocation choices: A theory of vocational personalities and work environments.* Englewood Cliffs, NJ: Prentice-Hall.

Howe, N., and Strauss, W. (2000). *Millennials Rising -The Next Generation.* New York: Vintage Books.

LeCompte, M.D. & Preissle, J. (1993). *Ethnography and qualitative design in educational research* [revised ed.]. San Diego, CA: Academic Press.
.
Patton, M.Q. (1990) *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage Publications.

Schaefer, K.G., Epperson, D.L., & Nauta, M.M. (1997). Women's career development: can theoretically derived variables predict persistence in engineering majors?" *Journal of Counseling Psychology*, 44(2), 173-183.

Schneider, B. L, & Stevenson, D. (1999). *The ambitious generation: America's teenagers, motivated but directionless.* New Haven, CT: The Yale Press.

Seymour, E. (1997). *Talking about leaving: why undergraduates leave the sciences.* Boulder, CO: Westview Press.

Super, D. (1963). Career development: self-concept theory - essays in vocational development. *College Board, 4.* New York: The College Board.

Tapscott, D. (1998). *Growing Up Digital.* New York: McGraw Hill.

Teenage Research Unlimited [Online newsletter], 2001.
http://www.teenresearch.com/home.cfm

The Lawlor Group. (2001, August). *A Secondary Research Report on Teens, Technology, and Trends.* Minneapolis, MN: The Lawlor Group.

The Lawlor Group. (2001, September). Proceedings from The Lawlor Institute Symposium: A Brand New "U", San Antonio, TX. [CD]. Minneapolis, MN: The Lawlor Group.

Thomas, Jim (1993). Doing Critical Ethnography. *Qualitative research methods series* (Vol. 26). Newbury Park, CA: Sage.

Thomas, Jim (2001, June). Keynote speaker at The Midwest Qualitative Research conference, Minneapolis, MN.

Yablonsky, L. (1969). *The hippie trip*. New York: Pegasus.

Young, D. (2000, November/December). Why women choose a career in engineering. *Society of Women Engineers Journal, 46,* (5), 44-54.

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