A South African Perspective on Self-Leadership Development for Women Engineering Students – A Pilot Study

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Abstract—Across the world, initiatives have been introduced to encourage women to enter into and remain in engineering fields. However, research has shown that many women leave engineering or suffer a loss of self-esteem and self-confidence compared to their male counterparts. To address this problem, a South African comprehensive university developed a self-leadership intervention pilot study in 2013, aimed at improving the self-efficacy of its female engineering students and increasing retention rates. This paper is a qualitative, descriptive, and interpretive study of the rationale and operational aspects of the Women in Engineering Leadership Association's (WELA) self-leadership workshop. The objectives of this paper are to provide a framework for the design of a self-leadership workshop and to provide insight into the process of developing such a workshop specifically for women engineering students at a South African university. Finally, the paper proposes an evaluation process for the pilot workshop, which also provides a framework to improve future workshops. It is anticipated that the self-leadership development framework will be applicable to other higher education institutions wishing to improve women engineering student's feelings of self-efficacy and therefore retention rates of women in engineering.

Keywords—Co-curricular interventions, Self-efficacy, Self-leadership, Women in Engineering.

I. INTRODUCTION

INTERNATIONAL research has shown that many women leave the engineering field or suffer a great loss of self-esteem and self-confidence compared to their male counterparts [1]-[8]. Informal research conducted at a South African comprehensive university during 2011, 2012, and 2013 showed that South African women engineering students have similar experiences [9]. The university has also collaborated with the South African Manufacturing and Services Seta (MerSETA[*1]) to respond to the need for more women in engineering in South Africa. From this collaboration in 2011, WELA, based in Port Elizabeth, South Africa was initiated.

In 2013, the WELA Leadership Development Programme (LDP) was registered as a formal university short-learning program and incorporated collaborative efforts with stakeholders within and outside the university. The goals of WELA are to focus on the academic, professional and personal development of South African women engineering

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students. In 2013, WELA initiated a longitudinal study to determine the self-efficacy of male and female engineering students at the university. The eventual aim of the study was to determine the impact of the WELA LDP on women engineering students. One aspect of this program was to propose a compulsory two-day self-leadership workshop aimed at empowering, motivating and developing participating senior female engineering students to improve their self-efficacy and retention rates both at university and beyond into their professions as engineers [9].

The paper describes the self-leadership workshop design that was to be presented as a pilot study to a small group of senior female engineering students and recently-graduated professional women engineers from industry.

II. OBJECTIVES

The objectives of this paper are to provide a framework for the design of a self-leadership workshop for women engineering students at a South African university and to propose an evaluation process for the pilot program, which also provides a basis for improving future workshops.

In particular, the self-leadership workshop aimed to address the problems women in engineering experienced with regard to self-efficacy. Self-efficacy can be defined as "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" [10]. Therefore, self-efficacy is a person's belief in his or her ability to succeed in a particular situation. There are four major sources of self-efficacy, namely, mastery experiences, social persuasion, vicarious experiences and physiological states and reactions [10]. Research shows that self-efficacy relates to self-belief and to positive outcomes and success for women studying and working in non-traditional male-dominated fields such as engineering [1], [11]. In addition, studies show that a person with low self-efficacy was more likely to lessen his or her efforts or give up altogether, whereas a person with high self-efficacy would try harder when faced with a challenge and respond better to negative feedback by increasing his or her efforts and motivation [12].

The self-leadership workshop was designed with the intent to empower female engineering students by providing them with an introductory exposure to global and national discourses around gender in the workplace, self-development and leadership. The underlying motivation behind the choice of workshop content was also to provide participants with a

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contextual framework for initiating and sustaining positive and constructive self-therapeutic engagement. As a result, it intended to increase self-knowledge, while also encouraging outward-looking engagement with peers and contemporaries in a supportive and collaborative manner.

The combination of these aims would also facilitate the development of self-efficacy by means of the four sources namely, mastery (of skills, knowledge and theories), social persuasion (through peer support and collaboration), vicarious experiences (through role modeling) and physiological states (through motivation, encouragement, self-reflection, and analysis) [10].

III. METHODOLOGY

This paper is a qualitative, descriptive and interpretive study of the rationale behind and design of WELA's self-leadership workshop. The workshop was inspired by the need for holistic, humane, contextualized, and collaborative development of female engineering students, who have been identified as a potentially at-risk group for academic failure, retreat from the profession and the potentially devastating psycho-emotional effects of low self-efficacy.

The design of the workshop was informed by integrative sociological and group dynamic approaches to training, underpinned by a qualitative and individualistic methodology. The workshop format was designed to incorporate a three-tiered professional development typology [13] consisting of formal (a compulsory module as part of a formal short learning program), non-formal (the orientational, contextualizing, and motivational intent) and informal (the emphasis on self-reflection, group work, peer support) aspects.

IV. DESIGNING THE WELA SELF-LEADERSHIP PROGRAM

Reference [11] proposes that effective collaborative relationships can have positive effects on participants. As a result, a Humanities and Social Sciences researcher and academic collaboratively developed the self-development workshop as well as an academic Engineering Head of Department. The intent of such a trans-disciplinary collaboration was to facilitate the merging of traditional engineering-styled analytical-based thinking skills with what is often seen as a dichotomously oppositional skill set from the Social Sciences and Humanities.

The workshop would be presented as a pilot project to a small group of students in their second year as WELA members and to some recently graduated female engineers. The workshop was designed to be presented over two consecutive days during the short university recess in September. This generally is a time when students experience heightened anxiety and stress owing to nearing examinations and concerns about their future careers. Senior students would also be preparing to enter the formal workplace for a year of experiential training as part of the formal curricula for qualifications in Civil, Electrical, Industrial and Mechanical engineering. The workshop would be presented on campus in an environment that was familiar to the participants.

Thirteen topics were to be included in the two-day workshop. The rationale for selecting these topics was based on identified problem areas that related to the self-efficacy levels in women in traditionally male-dominated environments [10], [1]-[8]. The intent was that the workshop would create mastery experiences through the attaining of skills, knowledge and theories as well as practice in meta-thinking (or thinking about how people think/reason), social persuasion experiences through peer support and collaboration, vicarious experiences through role modeling and role play, and improved physiological and psychological states through motivation, encouragement, self-reflection and analysis.

The following topics were incorporated into the workshop program. Design dimensions and intended outcomes that underpin each topic choice are indicated in brackets.

i. Self-efficacy: definition sources and challenges (Theoretical knowledge, collaboration and networking, practical application, self-development / reflection / analysis, meta-thinking).

ii. Fear, stress, anxiety, depression (Theoretical knowledge, collaboration, networking, practical application, role modeling, meta-thinking).

iii. Gender, sex, power and identity: social roles, expectations and stereotypes (Theoretical knowledge, self-development/ reflection/ analysis, practical application, meta-thinking).

iv. Practical application and contextualization: personal, disciplinary/ professional, institutional, local, national, global context (Self-development, reflection, analysis, meta-thinking, practical application, collaboration and networking, motivation and encouragement).

v. Changing global workplace (Theoretical knowledge, role modeling, motivation and encouragement).

vi. Organizational/institutional dimensions: communication, systemic violence, workplace bullying, relational styles and assertiveness (Theoretical knowledge, practical application, role modeling, meta-thinking, motivation and encouragement).

vii. Leadership: definitions, why people want to lead, why people follow, leadership styles, self-leadership (Theoretical knowledge, practical application, meta-thinking, collaboration and networking, self-development, reflection, analysis, motivation and encouragement).

viii. Language: self-talk, interior monologue, point of view/perspective, re-language-ing (Role modeling, practical application, collaboration and networking, meta-thinking, motivation and encouragement).

ix. Success and failure (Theoretical knowledge, role modeling, meta-thinking, motivation and encouragement).

x. Triad of success: belief, grit and habits (Theoretical knowledge, meta-thinking, motivation and encouragement).

xi. Trust, integrity, vulnerability, guilt and shame (Theoretical knowledge, collaboration and networking, meta-thinking, motivation and encouragement).

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xii. Compassion and Ubuntu (Theoretical knowledge, practical application/reflection/analysis, meta-thinking, motivation and encouragement).

xiii. Happiness: myths, types, life satisfaction, exercises (Theoretical knowledge, practical application, collaboration and networking, self-development, reflection, analysis, role modeling, motivation and encouragement).

The first three topics contextualize the experiences of women in male-dominated environments followed by practical application exercises (number iv). The next three topics (numbers v, vi, vii) relate to the changing global workplace and organizational dynamics. The remaining topics (numbers viii-xiii) focus specifically on strategies for self-development that influence and determine success. The topics would be presented through various mediums, such as formal presentation by the facilitator, video clips, group discussions, creative work such as drawing and writing, mind mapping, role-play and presentations to the group by participants. This was intended to achieve integrated application of skills, knowledge and abilities, the creation of group coherence, peer networking and peer association as well as an improvement in self-regard and self-esteem.

V. Evaluation of the Pilot Study

Participants would be requested to complete two sets of questionnaires, one as an orientation exercise at the start of the workshop; the other as an evaluation exercise at the end.

A. Self-Evaluation Orientation Questionnaire

An initial set of questions would be presented to participants with the intent of determining the experiences of participants in their engineering environments. The questions would be presented in a 7-point Likert-style questionnaire, with possible answers ranging from 'Always' to 'Never', and participants would be asked to rate their experiences and levels of anxiety/distress before the workshop starts. Seven points were used instead of five to eliminate the possibility of a 'safe' choice of the third and middle option on the scale. The following questions can be included:

My engineering environment experience:

i. My male colleagues and supervisors do not respect me

ii. I am not being taken seriously by my male colleagues and supervisors

iii. I feel that I have to do more than my male colleagues to prove myself

iv. Other women in my field are mean to me

v. I feel that I am not accepted in my field of study/work because I am a woman

vi. I have experienced gender discrimination/sexism in my work/study environment

vii. I feel intimidated/harassed/victimized because I am a woman

Participants would also be asked to rate themselves in terms of their perceived self-efficacy in their respective engineering work/study environments based on a questionnaire of 20 statements [11], [14]. They would again be asked to rate themselves on a 7-point Likert scale, ranging from 'No confidence at all' to '100% confident'. The 20 statements that participants would rate are as follows:

i. I can motivate myself even under difficult conditions

ii. I take responsibility for my decisions and actions even if I make mistakes

iii. I voice my opinion even when I know it is not the popular opinion

iv. I work well as a member of a team

v. I speak up when I see something that is wrong and should be changed

vi. I think of myself as a leader among my peers

vii. I can get along well with most people in most situations

viii. I am a good listener and spent time listening to what other people need/want

ix. I can communicate effectively and appropriately with a variety of different people

x. I can address and resolve conflict effectively

xi. I can make a difference or a contribution to a workplace

xii. I persevere in spite of challenges and set-backs

xiii. I am a happy person

xiv. I am not afraid to take risks even if it may result in failure

xv. I can manage my emotions quite well

xvi. I see mistakes as learning experiences

xvii. I am enthusiastic about my future career prospects in my chosen field

xviii. I cope well with failure

xix. I contribute sufficiently to team efforts like projects and meetings

xx. I am confident that I can lead a team effort in an area of my expertise

Answers received from each participant would be calculated to provide an individual total percentage for each. This would represent the perceived level of self-efficacy experienced by each participant.

B. Self-Evaluation Feedback Questionnaire

The same feedback form would also be completed at the end of the workshop. Hereby a second percentage for each participant would be obtained. The intention was to provide two comparable, informal sets of personalized data to determine whether there was an increase in perceptions of self-efficacy among participants immediately after the workshop. The same questionnaire would be submitted to participants at regular intervals (possibly a month, three months, six months and a year) after the workshop to determine whether the workshop's effect was temporary or more long-lasting. It is hypothesized that there would be a definite increase in perceived self-efficacy immediately after the workshop and that this would dissipate over time, but that the levels of perceived self-efficacy would not again be as low as before the workshop. A possible follow-up project would then be introduced in which regular sustaining follow-up sessions with participants were held to ensure the retention, or increase of, elevation in perceived self-efficacy among the

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participants. The levels of their self-efficacy could be tracked in this manner and a more longitudinal perspective obtained on the long term effects of the self-development intervention for female engineering students.

C. Feedback on Workshop

To conclude the workshop, the participants would be asked to provide feedback on the workshop itself. Course material, visual aids, media, variety of activities and exercises, appropriateness of examples, materials, and facilitation style would be rated. Participants would also be asked to identify ways in which the workshop could be improved. Finally, they would be asked to rate the different topics and aspects of the workshop as 'Uninspired', 'Informative', 'Fun', 'Motivational', Inspirational' and/or 'Transformational'. This would enable the workshop designers to improve on the design and presentation of the workshop in future to ensure the highest possible levels of effectiveness and success.

The feedback would be collated, summarized, and examined to establish if the aims and objectives of the workshop were achieved. Information obtained should give an indication of the impact of the workshop on the self-efficacy of the participants and whether the problems that participants faced as women engineers in a male-dominated environment were addressed by the workshop. Finally, the feedback forms would assist in determining if participants experienced the workshop as a rewarding experience.

VI. CONCLUSION AND RECOMMENDATIONS

As a developmental initiative, WELA is aimed at the academic, professional and personal development of women engineering students. This two-day pilot self-leadership workshop was an intervention aimed at increasing the self-efficacy of women engineering students while still in the educational environment and before they entered the professional world as working engineers. It is intended that the workshop would advance self-knowledge in participants, while also encouraging collaboration and networking with peers. In response to the outcomes and findings of this pilot study, recommendations could be made for future workshops. If positive feedback were received from participants in this pilot study, the workshop would be extended and developed as a formal co-curricular intervention and workshop for working female engineers. The workshop would then also continue as part of the current longitudinal study on self-efficacy of South African engineering students at the university.

*1. SETA is an acronym for Sector Education and Training Authority. The members of SETA include employers, trade unions, government departments and bargaining councils where relevant, from each industrial sector. The Skills Development Act (1998) provides a framework for the development of skills in the workplace. Amongst other things, the Act makes provision for skills development by means of a levy-grant scheme and the establishment of sector-specific Education and Training Authorities – or SETAs – to administer the scheme's funds and manage the skills development process [15].

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