2023-10-10

Towards Sustainability - Fostering Gender Dimensions for Inclusiveness in Science Technology Engineering and Production (STEP) Fields

Ann Sharon LOURENS
Nelson Mandela University, South Africa, ann.lourens@mandela.ac.za

Nicole TRUTER
Nelson Mandela University, South Africa, nicole.truter@mandela.ac.za

Recommended Citation

Lourens, A. S., & Truter, N. (2023). Towards Sustainability - Fostering Gender Dimensions for Inclusiveness in Science Technology Engineering and Production (STEP) Fields. European Society for Engineering Education (SEFI). DOI: 10.21427/GKSF-5C02

TOWARDS SUSTAINABILITY - FOSTERING GENDER DIMENSIONS FOR INCLUSIVENESS IN SCIENCE TECHNOLOGY ENGINEERING AND PRODUCTION (STEP) FIELDS

A Lourens [1]
Nelson Mandela University
Port Elizabeth, South Africa
0000-0001-9903-9607

N Truter
Nelson Mandela University
Port Elizabeth, South Africa
0009-0000-9772-3069

Conference Key Areas: Equality, Diversity and Inclusion in Engineering Education

Keywords: Inclusion, leadership, innovation, diversity, transformation

ABSTRACT

Statistics from the Engineering Council of South Africa indicate that a large number of women who enter the engineering sector leave their careers in the early stages because they felt isolated and experienced discrimination in this traditionally male-dominated industry. Furthermore, research on global trends have highlighted the importance of an inclusive atmosphere as a result of the increase in the proportion of female decision-makers, racial and ethnic background differences, persons with disabilities and generation gaps with resulting different learning styles and needs. Literature also suggests that workforce diversity that maximises inclusion and minimises resistance, allows organisations to create change that fosters the human potential of their employees to the extent that diversity could be an organisation's competitive advantage.

To assist with fostering a culture of inclusion a Leadership Development Programme (LDP) was designed for early to mid-career male and female employees in Science, Technology Engineering and Production (STEP) fields by the Women in Engineering Leadership Association (WELA) at a South African university. The focus of the four-day programme included leadership, communication, diversity, being a team player,

[1]*A Lourens*

ann.lourens@mandela.ac.za

lean management and tools for effective problem-solving in addition to a two-day practical team exercise in a simulated working environment.

This research paper outlines the study's theoretical framework and the results from a survey and industry focus groups that guided the design of the STEP LDP. The qualitative post-workshop data from STEP LDP participants is also discussed. The results illustrated the importance and perceived value of the programme to those who had participated. Accordingly, this paper also explores and reports on the transformation in thinking following the programme participation and provides feedback and suggestions to improve the LDP. Creating an inclusive environment in the workplace is a key factor for employee growth and satisfaction as well as promoting an inclusive leadership culture. It is recommended that similar programmes are presented by other universities or within organisations to foster inclusion, thereby facilitating employee retention, in particular, women in engineering.

Keywords: Inclusion, leadership, innovation, diversity, transformation

1 BACKGROUND AND INTRODUCTION

In 2011, with support from merSETA[1], the Women in Engineering Leadership Association (WELA) was established at a South African university. WELA goals include attracting, supporting and developing women engineering students (WES) to improve retention, not only of female students, but also women already working in engineering-related fields. The underlying premise of WELA was to improve the self-efficacy of WES through developing a sense of belonging. In accordance with this mandate, a LDP was developed for WES who are WELA members. The LDP, embedded in WELA, consists of various co-curricular interventions such as workshops, short courses, seminars and factory visits. Underpinning WELA is a mentoring programme that is offered by senior WELA members to junior WELA members.

With the WELA programme established to support WES, the WELA team endeavoured to further develop their mandate by designing a series of workshops for women working in engineering-related fields. Apart from informal feedback from women in the engineering field, statistics from the Engineering Council of South Africa (ECSA) indicate that a large number of women who enter the engineering sector leave their careers in the early stages because they feel isolated and experience discrimination in this traditionally male-dominated industry (Thompson, 2015). Furthermore, research on global trends have highlighted the importance of an atmosphere of inclusiveness, which is due to the increase in the proportion of female decision-makers, different racial and ethnic backgrounds, persons with disabilities and generation gaps with different learning styles and needs (Janakiraman, 2011).

Stevens, Plaut and Sanchez-Burks (2008) suggest that workforce diversity maximises inclusion and minimises resistance and allows organisations to create change that fosters the human potential of their employees. Mor Barak (2005) further suggest that diversity could be an organisation's competitive advantage. As a result, it becomes

[1]Manufacturing Engineering and related services sector education and training authority (SETA)

evident that the need for programmes that focus on the issues of inclusion, equity and diversity is valid, warranted and important.

Ramdass (2023) noted that women offer unique advantages in the corporate environment on projects that male engineers do not. One of these being the development of solutions that benefit society. Petersen (2023) goes on further to add that women experience things through a different lens and that thinking about designs from a different perspective enhances engineering concepts.

When the WELA team researched and developed a LDP for early career employees, it was also recognised that the programme should expand its reach to include more traditionally male-dominated fields than just engineering and that it should include all genders. Hence, it was decided to name to programme “Inclusiveness for innovation in Science, Technology, Engineering and Production (STEP) fields” for early career male and female employees.

This paper provides the theoretical framework and results from industry focus groups that guided the WELA-STEP programme design. Results from feedback questionnaires illustrating the value to those who participated in the WELA-STEP programme are discussed and therefore, this paper also explores and reports on the transformation in thinking following the programme participation and provides suggestions to improve the programme.

1.1 Gender Status quo

Various factors account for the low representation of women in science and engineering. It has been proposed that environmental factors (Shull & Weiner, 2002) such as isolation, exclusion from networks and lack of role models can be major source of deterrence for women in engineering. Women engineers also experience self-doubt in traditionally male-dominated environments as they feel that are not valued as highly in their positions (Thompson, 2015).

Institutional support and “fitting in” are listed as key contributing factors to the level of job satisfaction, and research indicates that women engineers have lower job satisfaction than their male counterparts. According to Fouad, Chang, Wan and Singh (2017), these two factors can play a significant role in the reasons that women engineers leave their positions. Fajardo and Erasmus (2017) suggest that South African women feel that they are going “against the grain” when they attempt to reach more senior positions, and this perpetuates the sense of isolation and exclusion from their male counterparts. Lack of women engineering mentors is compounded by the cycle of women engineers leaving their positions early in their career. In addition, Dennehy and Dasgupta (2017) highlight that mentors do not increase belonging or confidence, but merely preserve it. In their research, mentors were described as “social vaccines” as they inoculate the mind against the negative effects of this type of bias.

There is an African proverb that states, “If you want to go fast, go alone. If you want to go far, go together”. Expanding on the work of Paulo Freire, Price and Osborne (2000:29) believe that a humanising pedagogy is “a pedagogy in which the whole person develops [not just a facet of a person] and they do so as their relationships with others evolve and enlarge”. If women feel that they are excluded and “going alone” this emphasises the problem and a humanised pedagogical approach would include both males and females and towards a common goal of developing a person a whole.

The sections below explain the theoretical foundation and development of the WELA-STEP programme.

2 THEORETICAL FOUNDATION

The WELA LDP, designed for women engineering students, was developed with the four sources of self-efficacy as its foundation because of the benefits associated with increased self-efficacy (Marra, Rodgers, Shen & Bogue, 2009). As a result, it was argued that increased self-efficacy could contribute to WELA achieving its goal of developing and retaining WES. Therefore, the WELA-STEP programme was similarly designed to encompass the sources of self-efficacy.

2.1 Self-efficacy sources

Self-efficacy is defined as a self-evaluation or self-belief of one’s competence to execute successfully a course of action necessary to reach a desired outcome or goal (Badura, 1997). The four main sources of self-efficacy are mastery experiences, social persuasion, vicarious experiences and physiological states.

Bandura (1997) defines mastery experiences as having the raw knowledge, skills and experience required to complete a task or reach a goal. Social persuasion refers to the influence of others such as the presence of social support (Hazari, Tai & Sandler, 2007). Vicarious experiences occur when some form of involvement is experienced by observing someone else or a role model engaged in a task (Hazari et al, 2007). However, the effect is dependent upon the similarity of the role model to the individual’s own abilities and circumstances. Therefore, the visibility of women and minorities in the engineering field is of critical importance to attract, retain and support women in engineering.

Marra et al (2009) propose that the impact of physiological states and anxiety, in particular, in WES is identified in the literature as stereotype threats. This refers to the potentially debilitating performance anxiety experienced by those who belong to a group for which there is a negative stereotype related to a task. WES may experience debilitating anxiety in engineering-related careers and fields of study, owing to the stereotype in these fields being predominantly male.

For the design of the WELA-STEP programme, cognisance was taken of the four sources of self-efficacy, and the potential benefits associated with developing self-efficacy in an individual. The next step in the development of the STEP programme was to obtain feedback and input from women engineers and members of industry.

2.2 Industry and working women engineers' input

WELA received several informal training and workshops requests for early to mid-career women in engineering-related fields. Discussions with several experts in the field of leadership training and development, indicated that offering a course for women only could be counter-productive and negatively influence efforts to contribute to equality in the workplace. In addition, all indications were that early to mid-career males would also welcome leadership development opportunities. Therefore, the focus of a WELA-STEP programme would be to foster leadership skills to create an environment of equality and innovation.

Obtaining feedback and input from industry involved, as a first step, the development of questionnaire for women engineers to provide input on what they thought should be included in a course that could strengthen a woman's sense of belonging, inclusion and diversity. All participants were adamant that the programme should not include the "airy fairy, women are better than men, how to dress and etiquette" items along with leadership theory. The participants felt that they rather needed "leadership in action" when dealing with different types of people and addressing issues such as how to deal with stereotyping, bias, prejudice, discrimination and micro-aggressions. Other topics highlighted included sexual harassment, diversity and cross-cultural perspectives of leadership, work/life balance and "being a change agent and pulling the masses of males with you". Self-development related topics that were raised included personal mastery, resilience, conflict management, emotional intelligence and how to connect with male colleagues and not feel left out.

Feedback indicated a definite need for a developmental programme as "women are battling to establish their worth in a male-dominated society" and that new leadership skills should be taught, aligned "to women's natural inclination for a more collaborative and community driven approach which is culturally more sensitive". One respondent stated "women lose their drive to succeed due to challenges" and felt that although coaching sessions should be included, it might be difficult to obtain support for such a programme as "most management positions in SA remain predominantly male and they won't understand why gender specific training is necessary". Finally, they also shared that most women had been trained by males and, therefore, women often looked to men as role models and that technical know-how was not the challenge of their job, but rather the bias that they experienced in the workplace.

The second step in obtaining industry input was to invite a range of industry representatives to form part of a focus group discussion. The three focus groups confirmed the input of the questionnaire participants, adding that some components of the programme should contribute to CPD points and a focus on communication in terms of dealing with different generations as well as understanding work culture and ethics and how equality can contribute to innovation. They also suggested that the programme must be fun, hands-on and allow participants to reflect. Based on the feedback from questionnaire participants and the focus groups, various themes were identified (see Table 1).

Table 1: Summary of industry participants and focus groups

THEMES	DIMENSIONS	EXECUTION- PROPOSED CONTENT
Communication: reflecting heightened awareness of self and others	– Professional – Cultural – Across generations – Presentation skills	Practical day in the simulated working environment (SWEAT) laboratory, areas of focus to include communication, teamwork, diversity, conflict management and leading teams in STEP Additional sessions on social media management and presence, presentation skills, personal portfolio
Self	– Personal wellness – Emotional intelligence – Strengths and self-worth – Resilience	Participants asked to complete assessment forms (Strengths and Weaknesses) prior to the workshop. Their results, areas of improvements and strategies for improvements to be discussed during the workshop. Additional sessions on resilience
Mentorship	– Mentorship and networking	Mentors invited to take part in a "mentor speed dating" session whereby mentors and mentees can network
Leadership: to help embrace humility through serving and being authentic	– Dealing with change – Stereotypes – 2nd generation bias – Micro-aggressions – Conflict management – Innovation – Inclusiveness – Leading STEP teams	Practical day in the SWEAT lab, areas of focus include communication, teamwork, conflict management, diversity and leading teams in STEP Additional sessions on stereotyping, bias, and micro-aggressions
Workplace/Technical	Practical problem-solving	Practical day in the SWEAT lab, areas of focus include communication, teamwork, diversity, conflict management, ethics and leading teams in STEP

		Additional sessions on: • Lean (CPD points) • Problem-solving workshop (CPD points) • Project management short learning programme (CPD points)

From Table 1, it was evident that the greatest perceived needs were what is often referred to as soft or non-technical skills. Parlamis and Monnot (2019:1) stated that "the most difficult issues in managing organisations and the people who inhabit them involve organisational and relational skills; the soft stuff is actually the hard stuff". Parlamis and Monnot (2019) list skills such as leadership, teamwork, self-awareness, managing conflict, communicating effectively and getting along is essential for individual, team and organisational success.

WELA-STEP DEVELOPMENT TEAM AND PROGRAMME IMPLEMENTATION

Considering the above proposed content, the WELA team formed a task group to develop workshop content and to design the WELA-STEP workshop series. Apart from having access to experts in the various fields to act as facilitators of the various workshops, the WELA-STEP team also has access to the Simulated Working Environment (SWEAT lab) housed within the Department of Industrial engineering. The SWEAT lab consists of a continuous production line where a product is assembled and disassembled in production teams. The SWEAT lab is ideal for the practical application of operations and production principles, teamwork, communication, and conflict management, leadership, assertive and practical problem-solving.

The WELA STEP programme was widely advertised and marketed for two years (pre-pandemic). However, during both years, the response from industry was extremely poor although sponsorship was offered for programme attendance. Owing to the poor response in terms of sign ups and limited funds, some sessions were omitted when the programme was offered. The focus of the programme was the practical SWEAT lab session, which lead to the change in participant thinking. The programme content is included below

Table 2: Outline of WELA-STEP 2-day LDP

Themes	**Portfolio**
Practical problem-solving on the SWEAT lab	Lecturer: Industrial Engineer
Teamwork embedded in shared values and solving problems	Counselling Psychologist

Diversity to enhance the appreciation of different contributions and working with people from different demographics	Success Coach: School of Engineering
Communication reflecting heightened awareness of self and others, important in teamwork and problem solving	Counselling Psychologist
Leadership that helps us to embrace our humility through serving and being authentic,	Senior Academic Development Professional: Centre for Teaching, Learning and Media

The focus of the two-day SWEAT lab workshop was teamwork, communication, leadership, conflict management and inclusion.

Four counsellors or psychologists were contracted and allocated a team of participants to whom they would provide constant feedback in terms of their development during the practical two-day WELA-STEP programme. As an additional self-development measure, participants were sent three self-report measures to complete. These are assessments whereby participants report on their perceptions, behaviours, attitudes, beliefs and feelings. The self-report measures included the *Gift Profile* (Caroline Leaf) with its focus on multiple intelligences, *Hungry, Humble and Smart* (Patrick Lencioni) with the focus on being the ideal team player and, finally, *True Colours* (Don Lowry). The aim of the self-report measures was to provide insight, for each participant, into their respective perceptions, behaviours, attitudes, beliefs and feelings. Feedback to participants included a discussion of individual results of the three self-report measures along with their experiences during the workshop to assist participants personal development and leadership skills.

3 METHODOLOGY

The sections below described the workshop procedure, data collection process and participants demographic data.

3.1 Workshop procedure

Participants were divided into teams who had to assemble and disassemble a simple product on the SWEAT lab assembly line. This task was initially done without any instructions, and the teams had to figure out the process for themselves. After an allocated time period, the facilitator would meet with the teams and discuss aspects of quality, efficiency and time, allowing participants to improve their assembly process. Over the two-day period, several new requirements were added to the product, which required participants to find better and more effective means of assembling. This scenario allowed for real-life exposure to and practice of teamwork, leadership, communication, conflict management and inclusion. Throughout the two days,

theoretical sessions were presented to provide guidance and clarity as well as an opportunity to reflect on the highlighted aspects of teamwork, leadership, communication, conflict management and inclusion.

3.2 Data collection process

Participants were asked to complete a semi-structured questionnaire to provide qualitative feedback on their experiences during the workshop after they completed the two-day programme.

The focus of the workshop was teamwork, leadership, communication, conflict management and inclusion and the questionnaire focussed on gaining a deeper understanding of these issues. Qualitative data analysis aims to determine how participants make meaning of a specific event by analysis of their perceptions, attitudes, knowledge, feelings and experiences (Maree, 2019). All twenty participants completed the semi-structured questionnaire and their responses were captured on an excel spreadsheet.

When analysing qualitative data the goal is to summarise common words, phrases or themes into codes that would lead to understanding and interpretation of data (Maree, 2019). Welman, Kruger and Mitchell (2007) describe the purpose of coding as analysing and making sense of data that has been collected, therefore codes can be seen as labels that attach meaning to the raw data.

This study employed structural coding which is content-based and required identifying conceptual phrases representing the topic of enquiry. The coded segments that are similar are then collected for more detailed coding and analysis. The categories of codes are based on the topic of enquiry and are used throughout the coding process. Saldana (2009:66) proposes that this coding method is appropriate for data-gathering protocols, or exploratory investigations to gather major categories or themes. Structural coding is question-based that act as a labelling and indexing device, allowing researchers to quickly access data likely to be relevant to a particular analysis from a larger data set. Accordingly, responses were summarised and similar responses were grouped together to provide an indication of the perceptions of participants.

3.2 Participants

Participants were asked to complete feedback forms on the various sections of the two-day SWEAT lab workshop. Twenty participants representing four different racial demographics took part in the workshop thereby being truly representative of the South African nation (see Table 2).

Table 2: Age and number of participants

Age of participants	Number of participants	Gender

Up to 30 years	3 (15%)	3 female
31 – 35 years	6 (30%)	2 male 4 female
36 – 40 years	2 (10%)	2 female
41 – 50 years	7 (35%)	1 male 6 female
51 or more years	2 (10%)	2 female
Total	**20**	**20**

From Table 2, it can be seen that only 3 males participated in the course and 17 participants were female, ranging in age from their early twenties to two female participants over fifty years of age. The majority of the participants were over 35 years of age (55%), however, the results indicated that this type of developmental course is helpful to all ages. This course could be relevant to those who have never had the opportunity to attend any workshops or courses that focused on skills other than those relating to a specific job or task.

4 RESULTS

A summary of the participants' feedback is provided in Sections 4.1 to 4.8.

4.1 Perceived obstacles

The most frequently mentioned obstacles to progress were perceived to be a fear of failure or lack of confidence in oneself (35%), trust in colleagues or leadership (25%), frustration owing to working environment (20%) and not knowing oneself or what beliefs one has (20%).

As suggested by Stevens et al., (2008) workforce diversity maximises inclusion and minimises resistance, therefore providing training and workshops, especially in an environment such as the SWEAT lab allows for colleagues to better understand and therefore trust each other. This can lead to increased feelings of inclusiveness and belonging, especially for those belonging to minority groups.

4.2 Core personal value

For 55% of the participants, integrity was held to be the primary personal value. Three other values were mentioned by 20% of the participants, namely, strong work ethic, honesty/ethics and excellence/professionalism. With these values it is vital that participants are provided with the tools required to be confident in their roles and have a sense of belonging in their work environments. This contributes to employees living their values to make a difference to the success of the position they are in and the company, in the long run. Belonging is a feeling of security and support when there is acceptance and inclusion for employees, when employees feel they belong at work their performance and personal lives improve (www.diversity.cornell.edu).

4.3 Ease or challenges working in teams

There were a number of aspects that were believed to make working with someone easier. These included everyone understanding what their roles are (25%) and 20% identified clear communication or instructions. Some identified that if people were easy to work with, then the team worked well and helped each other. Twenty percent indicated that it was not easy if team members were difficult, did not communicate or were bossy. Therefore, it is vital that participants developed the self-confidence to address issues in a team environment and also communicate effectively with other members within the team both on a professional level and personal level (should issues arrive).

4.4 Self-discovery regarding problem-solving

Forty percent of participants believed that they were good at problem-solving and were able to “contribute at a high level”. Discussing the task before starting it and trying to think of smarter and more innovative ways to carry out the task were mentioned by 20% of the participants as an effective way of dealing with a problem. Therefore, as mentioned, communication plays a vital role in problem solving and various stages of the SWEAT line workshop allows for an opportunity to practice this. Being heard and respected as a team member and making a valid contribution in a small team, such within the WELA-STEP programme, can encourage women and lead to greater feelings of self-efficacy and therefore feelings of belonging and inclusion.

4.5 Diversity in the workplace

Diversity was considered essential in the workplace (35%) as it allowed the strengths and differences of all to be used (30%). There was only one negative comment about the impact of diversity in the workplace, namely, “race is a negative role towards me in terms of the ratio of the cultural mix in the work setting”. Two delegates felt it was not an issue at all and did not have any impact. The session on diversity was considered informative owing to hearing other participant’s views and ideas (25%), being accepting of others’ differences and neurodiversity indicating that diversities were not always obvious (25%).

If organisations embark on developmental programmes for men and women in traditionally male dominated environments it can lead to breaking down stereotypes and women feeling that they “are going against the grain” (Fajardo and Erasmus, 2017) and eliminated women’s sense of isolation and exclusion from their male counterparts.

4.6 Leadership in workplace

Twenty-five percent of participants were of the opinion that leadership should be consultative and that they should consult with their team members before making big decisions. Other comments related to the requirement that leaders be more open and communicate more with the staff (20%) and that not all leaders were good leaders

(15%). Three participants did not appear to be concerned about leadership in their organisation but preferred to focus on themselves.

Forty-five percent of participants realised that they still had a lot learn and there was still room for improvement before taking on the role of a leader. Twenty-five percent of participants believed that they had the potential to be a leader. Pocztowski (2003: 214) describes leadership as a process of influencing others so that they voluntarily engage in achieving an organisations goals. Parlamis and Monnot (2019:1) suggested that "the soft stuff is the hard stuff" . It is often not regarded by organisations as critical training, however, it can be seen that "soft skills' training is critical for organisational success and for creating understanding for issues o equality and diversity, and creating a sense of inclusion and belonging.

4.7 Shift in thinking

The shift in thinking came about with the realisation of the importance of knowing and understanding oneself (35%), followed by understanding the value of the difference between thinking about something and actually doing it (20%).

Many of the responses (35%) reflected the uncertainty that attendees felt in addressing their future. Sixty percent of participants recognised that they needed a significant shift in their communication in their personal lives and in the workplace. Forty percent mentioned that their communication needed to be more specific and concise and that the communicator should ensure that all had the same level of understanding. In addition, communication should always be positive, respectful, friendly and polite (25%). It was also mentioned that it must be understood that different people communicate in different ways and that one should not "jump to conclusions" just because someone communicated differently. Skills such as leadership, teamwork, self-awareness, managing conflict, communicating effectively and getting along is essential for individual, team and organisational success (Parlamis and Monnot, 2019). Therefore, the WELA-STEP workshop can make a contribution towards individual, team and organisational success. Focussing on changing mind-sets can lead to a friendlier and more inclusive environment for women in the field.

5 CONCLUSION AND RECOMMENDATIONS

It became evident that participants experienced a shift in thinking regarding their communication practises. This was triggered by the practical exercises, self-reflection and workshop sessions. In addition, it appeared that a large number of participants recognised that they required more self-development to become better future leaders.

Based on the responses from the WELA-STEP workshop participants, it was clear that development in aspects of leadership, communication, diversity were necessary for all employees. It was acknowledged that the sample on which the paper is based

consisted of a small number of participants, which should be further investigated. The workshop was designed based on the needs identified by industry members, yet some sessions had to be cancelled owing to a lack of interest. The question that could be asked is whether industry really needed and valued developmental programmes for early to mid-career employees, whether they were concerned with retaining women in scarce skills areas, whether they felt it was the responsibility of individuals to develop these skills themselves, or whether it was purely a matter of time, resources and being output-orientated. These questions need to be explored in a future study as they are pertinent for creating an inclusive environment in the workplace, which is a key factor in employee growth and satisfaction contributing to retention of, in particular, women engineers.

REFERENCES

[1] Thompson, M (2015), Women engineers quit over men's attitudes, *Mail & Guardian.* Retrieved from: http://mg.co.za/article/2015-08-22-women-engineers-quit-over-mens-attitudes. [Accessed on date].

[2] Janakiraman, M (2011), Inclusive leadership: Critical for a competitive advantage, *Berlitz*. Retrieved from: http://www.berlitz.com/SiteData/docs/BerlitzWPI/2b6dd531f5ed23d1/BerlitzWP_InclusiveLeaders hipFinal.pd. [Accessed on 29 June 2017].

[3] Stevens, F, Plaut, V & Sanchez-Burks, J (2008), Unlocking the benefits of diversity all-inclusive multiculturalism and positive organizational change, *The Journal of Applied Behavioral Science*, Vol. 44, pp.116-133. 10.1177/0021886308314460.S

[4] Mor Barak, ME (2005), Managing Diversity: Toward a Globally Inclusive Workplace, Michàlle E., Sage Publications, Thousand Oaks, California.

[5] Ramdass, N. (2023) *Industry needs to address challenges to retain female engineers*, *Engineering News*. Available at: https://www.engineeringnews.co.za/article/industry-needs-to-address-challenges-to-retain-female-engineers-2023-03-22#:~:text=Women%20encounter%20challenges%2C%20such%20as,Cesa)%20board%20member%20Naomi%20Naidoo. (Accessed: 26 June 2023).

[6] Petersen, R. (2023) *Industry needs to address challenges to retain female engineers*, *Engineering News*. Available at: https://www.engineeringnews.co.za/article/industry-needs-to-address-challenges-to-retain-female-engineers-2023-03-22#:~:text=Women%20encounter%20challenges%2C%20such%20as,Cesa)%20board%20member%20Naomi%20Naidoo. (Accessed: 26 June 2023).

[7] Shull, PJ & Weiner, M (2002), Thinking inside the box: Self-efficacy of women in engineering, *Int. J. Engng Ed*, Vol. 18, No. 4, pp. 438±446.

[8] Fouad, NA, Chang, WH, Wan, M & Singh, R (2017), Women's reasons for leaving the engineering field, *Frontiers in Psychology*, Vol. 8, p. 875. Retrieved from: https://doi.org/10.3389/fpsyg.2017.00875 [Accessed 6 July 2018].

[9] Fajardo, C & Erasmus, M (2017), Gender disparity in South Africa. Retrieved from http://www.bain.com/publications/articles/gender-disparity-in-south-africa.aspx [Accessed 5 July 2018]

[10] Dennehy, TC & Dasgupta, N (2017), Female peer mentors early in college increase women's positive academic experiences and retention in engineering, *Proceedings of the National Academy of Sciences*, Vol.114, No. 23, pp. 5964–5969.

[11] Price, JN & Osborne, MD (2000), Challenges of forging a humanizing pedagogy in teacher education, *Curriculum and Teaching*, Vol. 15, pp. 27-51.

[12] Marra, RM, Rodgers, KA, Shen, D & Bogue, B (2009), Women engineering students and self-efficacy: A multi-year, multi-institution study of women engineering student self-efficacy, *Journal of Engineering Education*, Vol. 98, No.1, pp. 27-38.

[13] Bandura, A (1997), Self-*efficacy: The exercise of control*, New York, WH Freeman and Company.

[14] Hazari, Z, Tai, RH & Sandler, PM (2007), Gender differences in introductory university physics performance: The influence of high school physics preparation and effective factors, *Journal of Science Education*, Vol. 91, No.6, pp. 847–876.

[15] Parlamis J & Monnot MJ (2019), Getting to the CORE: Putting an end to the term "soft skills", *Journal of Management Inquiry*, Vol. 28, No.2, pp. 225–227.

[16] Maree, K (2019), First Steps in research (3rd ed.). Braamfontein: Van Schaik Publishers:

[17] Welman*, C.,* Kruger, F., & Mitchell, B. (*2007*). Research Methodology (3rd ed.). Cape Town: Oxford University Press

[18] Saldaña, J. (2016) *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage Publications.

[19] Pocztowski, A. (2003), Zarządzanie zasobami ludzkimi: Strategie -procesy - metody, Polskie Wydawnictwo Ekonomiczne, Warszawa.

[20] *Cornell University* (no date) *Sense of Belonging* | *Cornell University Diversity and Inclusion*. Available at: https://diversity.cornell.edu/belonging/sense-belonging (Accessed: 08 June 2023).