



The Design of a Leadership Development Programme for Women Engineering Students at a South African University

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THE DESIGN OF A LEADERSHIP DEVELOPMENT PROGRAMME FOR WOMEN ENGINEERING STUDENTS AT A SOUTH AFRICAN UNIVERSITY

In recent years, there has been a growing recognition among educators, researchers, government and industry of the imperative to educate women engineering students in life and leadership skills that complement their engineering competence. It is believed that this combination will contribute greatly to the attraction and retention of women in the engineering field. The School of Engineering at a South African comprehensive university based in Port Elizabeth, offers formal qualifications in electrical, industrial, civil and mechanical engineering in addition to a degree in mechatronics. To ensure that the School of Engineering provides a comprehensive curriculum, the university offers various informal courses, maintains close links with industry, and service departments assist with co-curricular activities and student developmental activities. One of the initiatives housed in the School of Engineering is WELA (Women in Engineering Leadership Association) which is one of five projects initiated and managed by the University and the merSETA (manufacturing, engineering and related services sector education and training authority) chair in engineering development. WELA commenced in 2011 with the goal of focusing on the academic, professional and personal development of women in engineering. Further to these goals, the WELA leadership development programme was designed based on the university values, graduate skills required by industry, input from women engineers, women engineering students and other national and international leadership development programmes. The objectives of this paper are to provide a theoretical basis for the design of a leadership development programme; to provide insight into the process of developing a leadership development programme specifically for women engineering students at a South African university in the African context; and to propose an evaluation process for the programme. The findings will be used to provide guidelines for the engineering leadership development programme design specifically for higher education in Southern Africa.

1. Introduction

Women in engineering programmes are a crucial part of a country's response to the need for more women in engineering⁸. A South African comprehensive university based in Port Elizabeth, in collaboration with the merSETA (manufacturing and services seta*) responded to the need for more women engineers by initiating the Women in Engineering Leadership Association (WELA) in 2011. The goals of WELA are to focus on academic, professional and personal development of women engineering students (WES). Two successful years of growth and positive feedback from WELA stakeholders have led to the decision to re-evaluate and reflect on current WELA practices and the current WELA programme. Even if the current WELA programme relied heavily on the input and assistance of professional academic support services, the current WELA programme was mostly developed on intuition and experience of the WELA team members. This led to the decision to apply a more scientific, collaborative and informed approach to repackage the current WELA programme into a WELA leadership development programme (LDP).

According to Marra and Bogue⁹ effective collaborative relationships can have positive effects on participants including (a) higher achievement and improved productivity, (b) more caring, supportive and committed relationships, and (c) greater psychological health, social competence

and self-esteem. Furthermore, they propose that the reasons for these positive results are based on working relationships where participants can supplement each other's weaknesses or gaps in knowledge and skills⁹. Marra and Bogue⁹ also found that participants were able to combine their knowledge, experience and expertise to create a new understanding of problems in order to help each other achieve a desired goal. This collaborative partnership philosophy describes the relationship between the Women in Engineering programme director and an educational assessment specialist.

It was decided to apply the same philosophy, namely, combine input, skills, and expertise of various parties to create a new understanding of a problem to achieve a desired goal. In this case, the problem was how to develop an effective LDP for WES belonging to WELA.

Supporting Marra and Bogue's⁹ study and the goals of WELA, the WELA LDP framework was created with input and consideration of various factors and stakeholders, namely:

- i. current WELA programme consisting of co-curricular activities and workshops
- ii. university values
- iii. graduate skills required by industry
- iv. input from professional, working women engineers
- v. women engineering students
- vi. other national and international leadership and women development programmes

The result of combining input and knowledge from these components and stakeholders was the repackaged programme WELA LDP, which will be launched in 2013.

2. Designing a leadership development programme framework for WELA

The goals of WELA are professional, personal and academic development of WES. Therefore, it was important to develop the LDP framework on WELA's goals whilst considering the input of the selected stakeholders. In designing a leadership development framework for WELA, an important stakeholder to consider was the university in which WELA is housed. Therefore, the university values were contemplated, since they underlie how the university operates and its teaching and learning practices. For example, as it is an aim of the university that all graduates will have mastered graduate outcomes based on the university's values, these values were an important consideration in the design of the WELA LDP. It was also important to consider what other universities have done, both nationally and internationally to develop WES. The final two stakeholders whose views were taken into consideration were the women engineers already working as well as WES currently studying at the university. Input from all of these stakeholders was considered to develop a WELA LDP.

As a starting point to revise the existing WELA programme into a new WELA LDP, the existing WELA programme was investigated with a view of determining if it still met the goals of WELA in addition to responding to the input of the various stakeholders.

2.1 Existing WELA programme

At the time of writing this article, WELA had been in existence for two years (2011-2012). The WELA junior programme was offered in 2011 and the WELA senior programme was presented for the first time in 2012. At the end of 2012, it was decided to combine the junior and senior programs into one programme, namely, the WELA LDP.

The existing WELA co-curricular interventions and workshops were designed in partnership with the Student Counseling and Career Development Centre (SCCDC). The underlying premise of the co-curricular interventions and workshops were to improve the self-efficacy of WELA students. Bandura² proposes that self-efficacy determines:

...the courses of action people choose to pursue, how much effort they put forth in given endeavours, how long they will persevere in the face of obstacles and failures, their resilience to adversity, whether their thought patterns are self-hindering or self-aiding, how much stress and depression they experience in coping with taxing environmental demands, and the level of accomplishments they realise.

The four sources of self-efficacy include mastery experiences (positive experiences in completing tasks), social persuasion (social support), vicarious experiences (role models) and physiological states (eliminating stereotype threat)^{9,10,2}. WELA junior and WELA senior programmes were designed based on these four sources of self-efficacy and may be described as follows:

2.1.1 WELA Junior Programme

A developmental approach, which relates to proposals regarding the positive influences on the dimensions of self-efficacy as described by Marra and Brogue⁹ and Bandura² was adopted for the existing WELA junior programme. It consists of four main interventions presented by SCCDC. These include (a) an introduction to the concept of wellness and holistic development; (b) group assessments utilising the Wellness questionnaire for higher education (WQHE) and a strengths assessment; (c) feedback regarding the wellness and strengths assessments and information on how to devise a plan of action to address areas that the WES would like to develop further; and (d) four group workshop sessions which focussed on personal and career-related issues, namely, True Colours, a Team-building exercise, Assertiveness and Conflict Management, and Portfolio Development¹³. External training providers presented workshops on the choices that women face in their work and personal lives and on how to dress and behave professionally in the workplace⁶.

The principle was accepted that social support affects course achievement, as proposed by Marra and Brogue⁹. Therefore, in an effort to provide social support and create an identity for women engineering students, the engineering school secured its own WELA homeroom. In addition, in an effort to reduce stress and anxiety and to provide moral support, WELA members received examination survival packs⁶.

In celebration of the successful first year of WELA, an *Inspirational Students* booklet was published featuring the first WELA members. Professional photographs were taken of the WELA members, and each member wrote a self-reflective article on what it meant to be a part of WELA, and of the engineering world, as well as what they had learnt and gained during their

first year as WELA members ⁶. Special awards were given to acknowledge and celebrate academic and other achievements of WELA members.

2.1.2 WELA Senior programme

The WELA senior programme consisted of more engineering and leadership development type workshops and interventions, complementing the personal development approach adopted for the junior programme. Two workshops, namely, “An introduction to lean” and “Project management” was offered to students. On successful completion of a short learning programme, certificates were issued to add to the students’ personal portfolios. Other activities included:

- Senior WELA members took part in a technical project inclusive of all the engineering disciplines. This allowed the senior WELA members to practice their individual engineering specific skills, in addition to the project management, teamwork and presentation skills they had acquired. The project was organised and managed by the senior WELA members with a senior academic staff member acting as a mentor and coach.
- Complementing the newly acquired engineering related skills, a one-day workshop on ethical leadership was presented.
- A mentorship programme added to the senior WELA members’ development and responsibilities, in that the senior WELA members were trained as mentors for the junior WELA members.
- Senior WELA members attended a presentation workshop to improve their communication skills.
- WELA members attended a workshop on appropriate table manners, etiquette and netiquette.
- To provide the WELA members in particular with role models from industry and to prepare them for the working world, a discussion on “The road to success - a female perspective” was hosted in the WELA homeroom.

Table 1 summarises the influence of the existing WELA junior and WELA senior programmes’ developmental interventions and the expected influence on the self-efficacy of WELA members.

TABLE 1: Summary of the aspiring influence of existing WELA developmental interventions on the self-efficacy of WELA members

ACTIVITIES	MASTERY EXPERIENCES	SOCIAL PERSUASION	VICARIOUS EXPERIENCES	PHYSIOLOGICAL STATES
Wellness	x	x		x
Strengths assessment	x	x		x
True colours	x	x		x
Assertiveness	x	x		x
Conflict management	x	x		x
Portfolio building	x	x		x
7 choices workshop	x	x		x
Lean training	x	x		x
Project management	x	x		x
Panel discussion	x	x	x	x
Etiquette and netiquette	x	x		x

Ethical leadership	x	x		x
Presentation skills	x			
Wela members' publication	x	x	x	x
Wela women's publication		x	x	x
Technical project	x	x	x	x
Mentorship skills	x	x		x
Examination preparation	x	x		x
Wela homeroom		x	x	x

The four categories or dimensions used in Table 1 may be explained as follows:

Mastery experiences

Mastery experiences refer to positive experiences of completing a specific course. Merely becoming an official WELA member required a student's full attendance of all workshops. Therefore, each member already had a positive experience when she succeeded in fulfilling the requirements to become an official WELA member⁶. This was in addition to mastering the skills featured in the workshops they had attended.

Social persuasion

Social persuasion and social support refer to the influence of others on the WELA members participating in the programme. The WELA members supported one another strongly, academically, socially, and emotionally as they developed relationships with each other, and formed a cohesive group⁶.

Vicarious experiences and physiological states

Vicarious experiences occurred when an individual experienced some form of involvement by observing someone else engaged in a task. By means of vicarious experiences, participants might overcome the stereotypical threat of suffering debilitating performance anxiety. This is a result of belonging to a group for which there is a stereotype related to a task, and when they observe others who belong to the same group engage with the task successfully, they share the achievement¹⁰.

The effect of a vicarious experience is dependent upon the similarity of the model to the individual's own abilities and circumstances. Therefore, the mentorship programme, guest speakers and the *Inspirational women* booklet displayed women from a variety of races, ages and backgrounds. This proved to WELA members that women could be successful in a traditional male-dominated environment, irrespective of background, race and age⁶.

Integrating the existing WELA programmes

Based on the importance and relevance of improving WELA students' feelings of self-efficacy, the existing co-curricular interventions and workshops remained valid and necessary for the repackaged/revised programme.

The discussion of the existing WELA programmes served as the basis for the development of the repackaged WELA LDP. Next is a discussion with the university as a stakeholder, because when the programme was designed, the university was considered from the point of view of its values and desired graduate profile.

2.2 University values and graduate profile

The vision of the University is “to be a dynamic African university, recognised for its leadership in generating cutting-edge knowledge for a sustainable future”¹². The mission of the university is “to offer a diverse range of quality educational opportunities that will make a critical and constructive contribution to regional, national and global sustainability”¹².

The values of the university include respect for diversity, excellence, Ubuntu, integrity, respect for the natural environment and taking responsibility¹².

The university has also identified a desired graduate attribute profile so that an explicit description of the graduate the University aims to produce is established. For example, university graduates will be known for demonstrating in-depth disciplinary and interdisciplinary knowledge, social awareness and responsible citizenship, adaptive expertise, creativity and innovation, and critical thinking. A university graduate should also demonstrate strong intra-and interpersonal skills and effective communication skills¹². Having identified the university values and graduate attributes, these needed to be integrated into the new WELA LDP.

Integrating University values and the desired graduate profile

Graham, Crawley and Mendelsohn⁴ distinguish between “explicit” and “non-explicit” leadership agendas and define explicit programmes as:

...those where engineering leadership development is the primary and explicit objective, while non-explicit refers to programs [sic] which involve engineering leadership development, but [where] this may not be explicit and/or may be embedded within a broader remit of the program[sic].

In the case of the existing WELA programme, the university values were already an underlying factor embedded in its constituent co-curricular interventions, workshops and courses. For example, the developmental interventions that had to be attended to obtain WELA membership, completing of the short learning programmes, as well as the technical project were all rooted in the university’s values, namely, respect for diversity, Ubuntu, integrity, respect for the natural environment and taking responsibility.

To ensure that WELA members met the desired graduate profile, WELA members undertook a cross-engineering discipline project, which developed their adaptive expertise, creativity, innovation and critical thinking. Intra-and interpersonal skills and effective communication were also practiced throughout the WELA programme.

Based on these requirements, it is evident, although not explicitly cited in the programme, that the university’s values and desired graduate profile underlie its structure. Furthermore, to produce a woman-engineering graduate who is even more resilient, the WELA LDP would additionally include a two-day workshop “Self-leadership for women engineering students” which will include the following topics:

- Conceptualising the world we live in: global, continental, national, local, institutional
- Who am I in all of this? Mind-body-emotions-spirit, intellectual-emotional-spiritual-social, introduction to personal values, vision, mission, manifesto
- New ways of thinking about intelligence

- Anxiety and change management
- Compassion: seeking a definition, traditions (secular-spiritual; East/West/African), the role of compassion in our lives (self and others)
- Our greatest threat: blind obedience, historical context, current context
- Our saving grace: critical thinking and communication

This workshop would further emphasise and develop respect for knowledge of diversity, creativity, social awareness and responsible citizenship, adaptive expertise, creativity, innovation, critical thinking, Ubuntu, and taking responsibility for oneself.

The next step in devising the WELA LDP was to seek the views of women engineers and WES.

2.3 Women engineers and WES

Qualitative data collected from twenty-two working women engineers were explicit in recommending that women entering the workplace did not make gender an issue. The respondents were adamant that women engineering graduates must believe in their own worth and value. One of the woman engineers stated that women engineering graduates must use their strengths to highlight their abilities, as well as stand behind their opinions and decisions. Women engineers stated that it was important to work well in a team, but, on the other hand, it was also necessary to be self-sufficient and able to work alone and unsupervised. In general, they also rated communication and presentation skills as important.

In 2011, the university conducted an informal survey amongst first-year WES. Thirty-seven % of respondents indicated that they perceived that their biggest obstacles as an employee in a male-dominated work place would be discrimination and a lack of collegial respect. A further 20% listed intimidation by male colleagues and demoralisation as perceived obstacles, and 20% were of the opinion that male counterparts would not take them seriously⁵.

The 2012 informal survey indicated the greatest highest perceived challenges were being underestimated (50 % of respondents); sexism, in the form of not being taken seriously resulting in not being accepted (41% of respondents); and being seen as emotionally weak and unable to cope with a tough working environment (33% of respondents)⁷.

The survey results clearly indicated that WES displayed fears and insecurities about how they would be accepted and treated in a traditionally male-dominated field be it as a student or as a working engineer.

Integrating feedback from women engineers and women engineering students

The issues presented by women engineers and WES were mostly addressed by the Student Counseling and Career Development Centre (SCCDC) workshops discussed in Section 2.1. The components of the current WELA programme such as the Wellness questionnaire for higher education (WQHE)¹⁵, the strengths assessment, True Colours; Team-building exercise and Assertiveness and Conflict Management workshops were designed to improve the self-efficacy of WELA members to help them overcome their fears and concerns. The introduction of the Self-Leadership workshop in the new WELA LDP is aimed at further improving WESs personal belief in their capabilities to organise and execute the courses of action required to produce specific accomplishments and achievements.

When the WELA LDP was designed, after having investigated and integrated internal sources, namely, the current WELA programme, university values, the graduate profile and the opinions of women engineers and WES, the focus shifted to parties external to the university and its immediate community. Accordingly, other national and international women and engineering leadership development programmes were considered.

2.4 National and International programmes for developing women in engineering

An internet search revealed two active women engineering associations in South Africa. Firstly, South African Women in Engineering hosts a yearly conference with the aim of cultivating future leaders¹⁴. Their goals are to tackle social and engineering problems, and to provide mentoring and leadership development for executive members. Their philosophy is to empower people from within the organisation. Secondly, Group 5 and the University of Johannesburg formed Women in Engineering and the Built Environment¹⁵ to focus on professional women, existing engineering and built environment students as well as secondary school leavers. They provide networking opportunities, mentoring and academic support and create awareness of the engineering and built environment field^{16,11}.

On the international front, Graham et al.⁴ presented a snapshot review of engineering leadership education between September 2008 and March 2009. Their review focused on curricular and co-curricular programmes catering for engineering undergraduates. They consulted over 70 experts and investigated over 40 programmes. Graham et al.⁴ provided a summary of the significant programme activities of eight highly regarded engineering leadership programmes from across the world. The programmes include:

- Engineering leadership program, Iowa State University
- Teamwork and Leadership Module, Loughborough University
- Gordon-MIT Engineering Leadership program, MIT
- Leadership in a technological environment, Monash University
- Engineering Leadership Development Minor, Penn State University
- Leaders of Tomorrow, University of Toronto
- Global Engineering teams, Technische Universitat Berlin
- Constructionarium, UK University and Industry Partnership

Graham et al.⁴ found that all eight universities' leadership programmes were hosted within the engineering school and that all followed a projects-based approach. The programmes consisted mostly of articulated outcomes (88 %) and, therefore, most activities were curriculum based (75%). Students were exposed to campus based hands-on projects and faculty members (75%) provided mentoring in the majority of the programs. The information from Graham et al.⁴ was applied to develop the new WELA LDP. A summary of the most significant activities or themes across the eight university programmes is provided in Table 2. Table 2 is adapted from Graham et al.'s⁴ original summary to illustrate only the most popular (50% or more) significant activities or themes.

TABLE 2: Most significant themes of engineering development programmes

MOST SIGNIFICANT ACTIVITIES OR THEMES	NR	%
Central programme themes		
Contribution to society or environment	5	63
Professional practice and partnership	5	63
Content and educational approach		
Uniting leadership seminar/workshop	4	50
Personality profiling exercises	4	50
Leadership/business theory	5	63
Articulated learning outcomes	7	88
Project based approach	8	100
Leadership practice opportunities		
Residential off campus camp or retreat	5	63
Campus based hands-on project	6	75
Reflection, guidance and assessment		
Reflective journals/portfolio	4	50
Self-evaluation	4	50
Peer-evaluation	4	50
In-house assessment tools	4	50
Mentoring by faculty, industry etc	6	75
Structure and organisation		
Co-curricular elements	4	50
Competitive application and selection process	4	50
Program in existence for over five years	5	63
Curricular activities	6	75
Governance		
Housed within the engineering school	8	100

Graham et al. ⁴ provide the following definitions of the significant themes or activities referred to in Table 1:

Central programme themes are defined as:

...the key theme/s around which the activity is centered and which is embedded throughout the program [sic]. For example, those programs[sic] identified with a ‘*global/cross-cultural*’ theme may involve students spending a portion of their time overseas, cross-national project teams with overseas partners or a significant focus on developing students’ cross-cultural understanding ⁴.

As argued in Section 2.2, the university values and graduate attributes were embedded in the existing and new WELA LDP where the central theme was academic, personal and professional development.

Content and educational approach signifies:

...the overall educational approach, structure and content of the programme. For example, this section will identify whether the programme includes an ‘*intensive transformational*’ experience” where students are fully immersed in a deliberately challenging activity over a defined period or whether the programme holds a regular

“*leadership seminar/workshop*” designed to unite the cohort around the central programme ideas⁴.

The WELA LDP may be described as a transformational experience where students are fully immersed in deliberately challenging and changing activities over a defined period.

Leadership practice opportunities are:

...the opportunities provided for students to apply and hone their leadership skills. This section identifies the practical opportunities offered for leadership practice, such as ‘campus-based hands-on projects’ (such as Formula SAE), intensive ‘residential off-campus retreats’ or opportunities for ‘mentoring or coaching of more junior students’⁴.

In the existing WELA programme, Senior WELA members are trained as mentors. The mentorship programme, in addition to the technical project, offers leadership practice opportunities for WELA members.

Reflection, guidance and assessment refer to:

...the mechanisms used to encourage students to reflect on their leadership development, the guidance offered and the student assessment processes used. For example, this section will identify whether programs facilitate students to develop *reflective journals*, whether *peer-evaluation* is employed or whether the programme/institution have developed *associated assessment tools* specifically tailored for engineering leadership and used within the programme⁴.

As proposed by Athreya and Kalkhoff¹, reflection and self-awareness are emphasised as crucial to leadership development. Therefore, existing WELA members developed personal portfolios that included a self-reflection diary to track individual development.

Structure and organisation are:

...how the overall programme is structured and organised. For example, this section will identify whether there is a *competitive selection process* for admittance to the programme, whether the programme has developed any *associated research projects* in engineering leadership, whether the programme is offered as a *curricular* and/or *co-curricular* activity or whether there is a focus on *dissemination of the program’s outcomes* outside the institution⁴.

All WES are invited to join WELA. However, in order to become a WELA member certain course attendance requirements must be met by aspiring WELA members. Those who meet the requirements are known as WELA members and enjoy the benefits of the homeroom and other co-curricular activities.

Governance signifies:

...how the overall programme is administered. This section covers aspects such as whether the programme is predominantly *student-led in its design and direction* or whether *external expert groups* are engaged to provide guidance and advice to the programme development team⁴.

A team consisting of academics and professional support services personnel develops the existing WELA programme.

Graham et al⁴ also propose three trends for engineering leadership education in the future, including:

- **Global engineering:** increasing focus on the student’s ability to operate in complex, international, multi-disciplinary teams and a strong awareness of cultural differences and their approach to engineering problems
- **Programme collaborations:** more development of cross-national partnerships between engineering leadership programs, to offer students’ extensive global exposure
- **Self-analysis and reflection:** awareness building of students’ personal skills set, how it affects their lives and leadership abilities and the provision of a tailored programme to accommodate each student’s individual developmental needs.

Integrating best practice from national and international programmes

In the existing WELA programme, Senior WELA members were trained as mentors. However, owing to academic workload and timetable constraints, the mentoring programme has not achieved optimal success. For this reason, and also to help bridge the gap between the university and the workplace, mentors from within the institution as well as industry will act as external mentors to both junior and senior WELA members for the WELA LDP. To facilitate networking opportunities further, factory visits will be organised in addition to other networking functions. Factory visits will not only allow networking opportunities, but will provide a greater understanding of the world of work.

Based on Graham et al.’s⁴ proposals for future trends, and the “central programme theme” definition⁴, to expose WELA members to different ways of thinking, the WELA LDP will include a workshop on global engineering aimed at creating awareness of cultural differences. For greater global exposure, WELA members will be encouraged to take part in the university’s international exchange programmes. Several discussions are taking place with internal university partners to expand exchange programmes specifically for WELA members.

With reference to the category “content and educational approach”⁴ the WELA LDP may already be described as a transformational experience where students are fully immersed in a deliberately challenging and changing activity over a defined period. However, the ethical leadership workshop will be expanded to include more leadership theory and training. It will also include guest lectures from women engineers in leadership positions in their respective fields. To create more “leadership practice opportunities”⁴ in addition to the mentorship programme, more WELA members will be encouraged to take part in the technical project. In 2012, WELA members designed a Water harvesting system; and in 2013, they will take the project from the conception to the execution phase. The technical project allows for cross-discipline interaction, communication, teamwork and development of leadership skills. In addition, it allows the WELA members to apply their newly acquired project management skills acquired from attending the Project Management short course.

The structure and organisation of the WELA programme will remain as it is with the programme still based on co-curricular activities. As was the case before, while WELA membership will be voluntary, membership will require meeting the workshop attendance criteria in year one. In order to qualify for a WELA LDP certificate, WELA members will also have to meet certain criteria relating to attendance and assessment results.

3. Summary of WELA LDP

Based on the current WELA programme, the university values and the desired graduate profile, input from women engineers and WES, national and international leadership development programmes, the WELA LDP will consist of co-curricular activities be in the form of workshops and short learning programmes. These are activities are summarised in Table 3.

TABLE 3: WELA LDP co-curricular interventions

ACTIVITIES	WORK-SHOP	SHORT LEARNING PROGRAM	SEMINAR	ENGINEERING PRACTICE	OTHER
Wellness	X				
Strengths assessment	X				
True colours	X				
Assertiveness	X				
Conflict management	X				
Portfolio building	X				
Choices workshop	X				
Lean training		X			
Project management		X			
Panel discussion			X		
Etiquette and netiquette			X		
Leadership practice		X			
Presentation skills		X			
Mentorship training	x				
Examination preparation	x				
Self-leadership	x				
Global engineering	x				
Technical project				X	
Factory visits				X	
Networking			X		
Exchange program				X	
Inspirational women and students publication					x
Exam survival pack					x

Due to the academic workload and the existence of several other initiatives within the engineering school, it is realistic to provide WELA members the opportunity to complete the programme summarised in Table 3 over a three-year period.

4. Challenges

The challenge remains to secure sufficient funding to present WELA initiatives. The challenging engineering curriculum not only brings about academic challenges for WELA members, but also influences the time they have available for co-curricular interventions.

5. Conclusions, recommendations and future research

The objectives of this paper was to provide a theoretical basis for the design of a leadership development programme and to provide insight into the process of developing a leadership development programme specifically for women engineering students at a South African university in the African context. The WELA LDP framework was designed on the input and feedback from various stakeholders, and aims to provide personal development as well as academic development to prepare WELA members for work and life.

In 2013, in partnership with SCCDC colleagues, the university will embark on a longitudinal study to measure the self-efficacy of women engineering students before and after the WELA interventions at the university. It is also envisaged that an international university will be involved in the study as from 2014. The longitudinal study will provide a clear indication of the success of the WELA programme in influencing feelings of self-efficacy in women engineering students who have taken part in it. To determine the success of the WELA LDP, several role players will be asked to complete questionnaires, including the WELA LDP participants and their mentors.

The results of the longitudinal study in addition to the results of the questionnaires will be an indication whether WELA is educating students in life and leadership skills. It is also believed that developing these WES will contribute to the retention of women in the engineering field.

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* **SETA, is an acronym for Sector Education and Training Authority.** *The members of a 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 sector-specific Sector Education and Training Authorities – or SETAs – to administer the scheme's funds, and manage the skills development process*³.