



The Sasol Engineering Leadership Academy

(Part of the Sasol Chair in Safety Health and Environment initiative in the Department of Mining Engineering, University of Pretoria)

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Synopsis

Contrary to the way it is often portrayed, the average organization or company is far from being a cold, calculating machine. It is actually a highly emotive place where interaction with people is a fundamental part of its ability to perform satisfactorily.

The company, through its employers, expects employees, including new graduates, to have the ability to cope adequately with this emotive environment. The graduate is frequently unable to meet this expectation because he/she has not been developed to do so. Technical knowledge is his only asset. This deficiency manifests itself in leadership shortcomings, both intrapersonal and interpersonal. Further analysis reveals a deficiency in three elements of leadership – self-awareness, oral communication, and an ability to work cooperatively in teams.

To address these three elements of leadership, Sasol Coal, a subsidiary of the big petrochemical company in South Africa, sponsored a leadership programme at the University of Pretoria for their final-year bursary students in the faculty of Engineering. This programme, the Sasol Engineering and Leadership Academy (SELA), consisted of a number of interventions designed to address the three areas of self-awareness, oral communication, and cooperative behaviour in teams. These interventions varied from an intrapersonal nature to interpersonal aspects. Psychometric assessments were followed by experiential modules dealing with the three constructs.

SELA was evaluated at the end of the year. The results showed a positive shift in the main constructs of self-awareness, communications, and cooperation. This was measured quantitatively and qualitatively. Conclusions were drawn and recommendations for improving the programme were proposed.

Keywords

leadership, self-awareness, communication, group work.

Introduction—the problem

Most engineering schools have been reluctant to get involved in developing soft/leadership skills in undergraduates, in spite of the fact that it is not possible to neatly and clinically separate technical skills from leadership skills.

Graduates leave university with an abundance of solid technical knowledge, but with low leadership indicators (as shown on psychometric assessments conducted at the beginning of their final year of study) to support this knowledge. It is not possible to function optimally as an engineer with only the technical knowledge, no matter how hard-won and vitally important it is.

As an example of these shortcomings, the Department of Mining Engineering at the University of Pretoria has assessed emotional intelligence levels and other behavioural attributes in final-year students over the past few years. The results show marked deficiencies in certain important intrapersonal and interpersonal constructs. These constructs or skills are vitally necessary in complementing technical knowledge in view of how much time an engineer spends in association with people and in forging effective working relationships. This association with people takes place from day one. The new graduate is immediately put to the test on 'people' issues, having received meagre instruction or practice in applying basic leadership skills.

Graduates go through a type of identity transition when they enter the workplace, despite having worked during their vacations at various companies. Those experiences are ephemeral – entering the workplace as a permanent employee is different. This transition from student to employee can and does cause all sorts of anxieties, justified or otherwise. According to the psychometric assessments for final-year students in the Department of Mining Engineering for the last three years, many students are not well equipped to cope with the exigencies of the real world. In particular they are confronted with people/soft issues, either in themselves or in others, that require leadership skills to resolve.

Literature survey

Griesel and Parker (2009) highlight the different positions taken by employers and the role of higher education in meeting the skills'

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needs of graduates. Employers cite gaps between 'what they get' and 'what they expect' in graduates. Communications (written and oral), openness and flexibility, self-motivation and initiative, leadership ability, ability to relate to people, and teamwork are among the attributes showing the largest gaps. In an empirical study of young graduates conducted by the first author, the absence of soft (leadership) skills or poorly developed soft skills were frequently mentioned as something they would have wanted to learn at university (Knobbs, 2012).

Both employers and young engineering graduates arriving at the workplace for the first time have identified 'gaps' or 'deficiencies' in the graduates' knowledge and skills. Scott and Yates (2002) asked engineers to rate those attributes most important for success and to what extent these attributes were taught or developed at university. Principally, the gap is in 'people' skills and is a consequence of poorly developed leadership attributes, of both an intrapersonal and interpersonal nature.

Male *et al.* (2010) refer to a 'skills gap' when comparing what employees want from engineering graduates with what graduates bring to the work place. They identify in their survey that the soft skills missing in undergraduate education are communications, self-management, attitude, problem solving, and teamwork. Nair *et al.* (2009) confirm this and showed that communications and interpersonal skills are the two most significant deficiencies in graduates.

Communications, responsibility, and self-confidence are the three main challenges that graduate engineers face when entering the workplace according to Baytiyeh and Naja (2012). The importance of people management skills and oral communication skills for success as an engineering manager is demonstrated by Saunders-Smiths and De Graaff (2012). Their research shows that 'technical' comes last on the list of 12 attributes. For engineering specialists the reverse was the case, although communication skills featured prominently.

In their sample of early-stage chemical engineering graduates Martin *et al.* (2005) identify, through a questionnaire and interviews, several gaps, not the least of which are practical knowledge, interpersonal skills, and management/leadership. A survey of skills required for effective project management singled out six skills, four of which were soft skills – interpersonal communications, people management, team management, and problem solving; leadership skills followed close behind (Tong, 2003).

Martin *et al.* (2005) investigated non-technical competencies such as communications, teamwork, life-long learning, and attitude among chemical engineering graduates. The graduates stated that they had acquired good general communications skills from their undergraduate education. Interpersonal skills were highlighted and seen as the vital link between communications and teamwork. On the matter of teamwork they were divided as to whether the university had prepared them well. The graduates in the survey declared that the university had not prepared them adequately for leadership roles. In another report from the aerospace industry, communications and the ability to function in teams were highlighted as part of what the broad engineering education should include (McMasters, 2003).

Sageev and Romanowski (2001) concentrated on technical communications among graduates who had

attended a course on this subject as undergraduates. They recommended that communications should be made an integral part of the engineering degree. The graduates said that communication skills had helped to advance their careers. Oral presentations, group discussions, and persuasive language were all stressed as important elements in their technical communications programme. The programme was roundly endorsed by the workplace, which gave its input into promoting, advancing, and improving the course.

Oral communications are recognized as a major attribute for practicing engineers, who spend much time in discussion and conversation (Darling and Dannels, 2003). This study of practising engineers reported on the types of communication and the audiences that engineers have to deal with. The environment was succinctly described as an 'oral culture'. A programme to teach communication, leadership, and teamwork was instituted at the University of Tennessee in response to calls from industry employers and engineering educators. Assessment of the efficacy is done by means of a peer evaluation survey, with plans to introduce a longitudinal study measuring behavioural changes (Seat *et al.*, 2001). This is another example of where teaching skills (as opposed to inculcating knowledge) and improving self-awareness is a precursor to developing or influencing leadership capabilities.

A major survey conducted by the National Academy of Engineers (2005) refers to a number of attributes that engineers should display to be truly successful. These attributes are accredited by the Engineering Council of South Africa and are listed as follows:

1. Strong analytical skills
2. Practical ingenuity
3. Creativity
4. Communication
5. Business and management principles
6. Leadership
7. High ethical standards and a strong sense of professionalism
8. Dynamism, agility, resilience, and flexibility
9. Life-long learners.

Motivation

The workplace can be a harsh environment when requirements for assimilation and success, as seen by employers, are not fully met by the knowledge and skills that young graduates bring to the company straight from university. Apart from a dearth of practical engineering experience, students lack soft skills/leadership acumen and the ability to deal with the people issues that arise in the workplace. This can lead to unhappiness and frustration affecting their incorporation into the culture of the company and their ability to make meaningful contributions and to advance their careers. It is postulated that this lack of leadership skills, principally self-awareness, communications, and cooperation (working in groups) is a gap in their toolbox and its significance is recognized by employers and graduates alike.

These identified deficiencies or gaps hamper the graduates' ability to assimilate and to adapt to life in the 'real world'. Furthermore, they can cause anxiety and frustration, and even thwart their career advancement. The ability to

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adapt successfully affects retention and motivation, and can be a serious problem in some sectors of the industry. Sometimes, traumatic entry into the workplace causes young graduates to seek their fortune elsewhere. And if they are fortunate enough to be appointed or considered for an appointment as a supervisor early in their careers, they are often ill-equipped to take the position. Early intervention to develop leadership skills is needed.

In the opinion of the first author it seems reasonable, if not essential, to equip these young engineers with the necessary fundamentals of leadership to make their entry into the workplace less traumatic and equip them to perform adequately. It is postulated that these fundamentals of leadership, be they intrapersonal or interpersonal skills, can be developed by concentrating on the three leadership constructs of self-awareness, oral communication skills, and group co-operation skills.

According to Yorke and Knight (2006) employability is influenced by four interrelated components, namely: skills (communications, management of time and self, problem-solving, and life-long learning); a field of knowledge; identity and self-worth; and meta-cognition (self-awareness and reflection).

Objectives

SELA's main objective is to instil enhanced leadership skills into a group of final-year engineering undergraduates. Self-awareness, oral communications, and working co-operatively in groups were selected as the main 'drivers' of this leadership development programme. Changes in these three elements were measured qualitatively and quantitatively.

The model in Figure 1 illustrates the structure of the leadership problem and how SELA addressed this:

Methodology

Data was collected at the beginning of the programme in February by means of three psychometric instruments – *Shadowmatch* (habits and behaviour), *EQI* (emotional intelligence), and *HBDI* (thinking styles). SELA consisted of 32 students, mostly final-year undergraduates with SASOL bursaries. They came from a number of different departments in the Engineering (EBIT) faculty, with the largest group from chemical and mining engineering. This multidisciplinary composition of the participants proved to be one of the real boons of the course.

To measure the possible change in self-awareness, communications, and working cooperatively within small groups, a mixed method approach was employed. The *Shadowmatch* assessment measuring the behavioural habits of the group was administered at the beginning of the programme and again after the programme to map possible changes in the behaviour of the students. A qualitative-quantitative questionnaire was used after the course to detect the changes in perception from the students about themselves. The other two instruments, *EQI* and *HBDI*, were not repeated due to cost constraints.

Intervention

The philosophy adopted for the interventions in the leadership programme was driven by the Harvard model

derived from the US Army officers' course of *knowing-doing-being* (see Figure 2). The *knowing* part emphasizes the cognitive domain or knowledge about leadership (least addressed in SELA). The *doing* part emphasizes behavioural aspects and essential skills leaders need – it is about learning by experience. The *being* part concentrates on the identity, character, and values of leaders. It is essentially about who they are (self-awareness).

The course was presented in eight contact modules within the full group and held on Saturdays (this was the only arrangement that could cater for the multidisciplinary

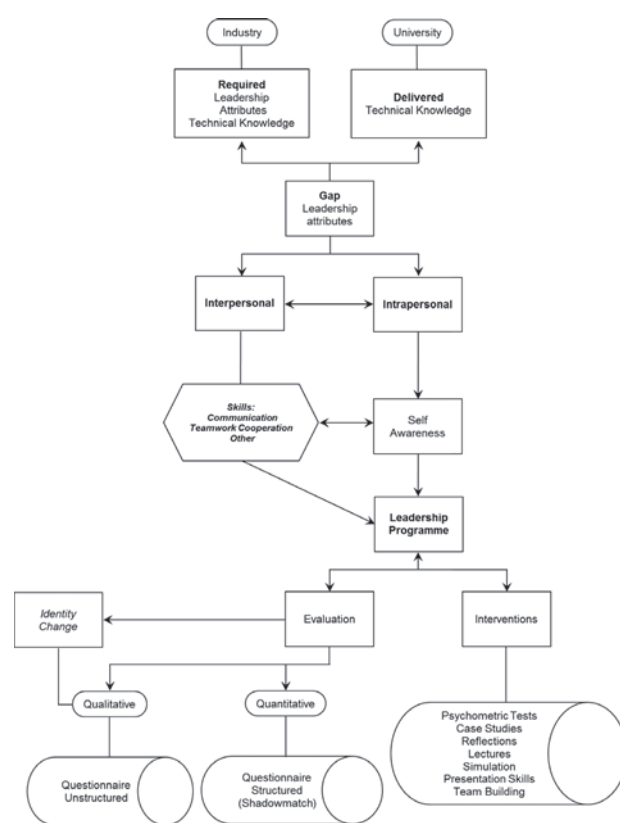


Figure 1 – Bridging the gap

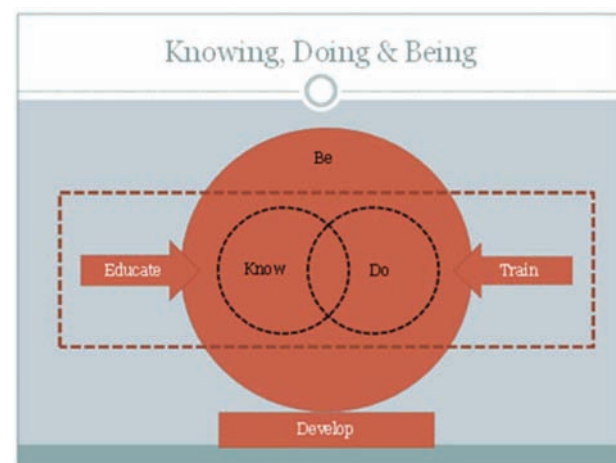


Figure 2 – The Harvard Model (Snook et al., 2012)

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composition of the group). Appendix 1 shows the programme of modules with the various interventions. Between modules, which were approximately one month apart, case studies were examined. Smaller groups of four students were formed. These groups discussed the cases among themselves and then met with the first two authors in a coaching session. Oral communications and group collaboration were emphasized.

At these sessions, the group presented its findings and through discussion and debate students were prompted to further tease out hidden issues in the case studies that may have been overlooked. Not only were students exposed to real-life situations of human behaviour, which was instructive in itself, they were interacting as a group and experiencing all the issues associated with group performance like conflict and communications. An hour was allocated for the small group discussion and an hour for the coaching sessions.

Groups were changed after every two modules to give everyone an opportunity to interact with as many of their fellow students as possible. This practice mimics the situation in real life, where an individual will probably be a member of more than one group and may find himself moved from one team to another frequently.

Module 1 concentrated on the completion of three assessments, which were done in a computer laboratory on campus. The assessments used were the Herrmann Brain Dominance Instrument (*HBDI*) (Herrmann, 1996), *Shadowmatch*TM (2009), and the *EQ-i* (Bar-On, 1996). These assessments were selected to assess and develop the main three constructs of focus in the leadership programme, namely self-awareness, communications, and co-operation (teamwork). *HBDI* measures individual thinking styles and lends itself to illustrating all three constructs in a useful way. *Shadowmatch* measures behavioural habits and calculates the similarity or differences in habits of people in a certain environment. *Shadowmatch* also has a team assessment functionality, which enriches teamwork in the smaller groups. *Shadowmatch* has the ability to generate individual performance programmes, which some students embraced with the help of a mentor. *EQi* was used mainly for detecting emotional self-awareness and to enhance the appreciation of emotional concepts, which students are not used to dealing with in an engineering curriculum.

Modules 2, 3, and 4 dwelt on the results of these assessments. The results were discussed with the participants, who not only learned about themselves (self-awareness) but also about their fellow students with whom they were interacting on a regular basis, and particularly when sitting in the same small groups together. By the end of module 4, students had an overview of the intrapersonal matters that made up the foundation of the self-awareness part of leadership.

The second four modules concentrated on the interpersonal aspects of leadership, starting with presentation skills, where two members of the Department of Speech and Drama were brought in as facilitators. Module 5 was spent mainly on communications and watching a case study where a jury needs to decide on the outcome of a murder case. The last module was a simulation exercise covering the contro-

versial 'fracking' process. The small groups represented different stakeholders negotiating fracking in the South African context.

Reflection

Writing reflections is an integral part of leadership development, and commentary on the facets of self-awareness, oral communication, and cooperation in the programme was encouraged. The connection between leadership and personal reflection is intended 'to maximise individual potential by allowing students to evaluate the significance of their experiences from a leadership perspective' (Densten and Gray, 2001). Students were encouraged to reflect on how they felt about the programme after each module and to critically explore their feelings and thoughts in a confidential written document of no more than one page. The facilitators made comments and suggestions before returning the reflection paper to each student.

Some students wrote reflection papers regularly, expressing discovery or anxieties aroused by the programme. Some students wrote sporadically, a few never wrote at all. The multidisciplinary composition of the participants proved to be one of the real virtues of the course according to participants.

Results

SELA's objectives of improving, understanding, and developing skills in the main three tenets of leadership were measured qualitatively and quantitatively through a questionnaire. The questionnaire was used to evaluate the students' perceptions of the changes in self-awareness, communication skills, and their skill in working in small groups. Participants completed a comprehensive questionnaire and the *Shadowmatch* assessment was repeated at the end of SELA.

Qualitative: unstructured questions in questionnaire

Students rated the enjoyment and efficacy of each intervention. Clearly some interventions were not as highly regarded as others. The case studies proved to be difficult for many of the participants, who as engineering students were seeking more structure and solid solutions to the problems unveiled in the case. There seemed to be a measure of discomfort in examining 'messy' human behaviour issues. This probably accounts for the low rating given to case studies as an intervention.

The unstructured questions solicited many comments, too numerous to mention in total. The following comments are samples of some of the questions and statements made by the participants:

Question 2. What aspects of the course did you enjoy?

Students answered this question in favour of group work, being able to learn about and practice presentations, and the opportunity to meet and interact with people they did not know. Quoted samples of some of the reactions were:

'Being forced to work in groups and presenting part of a case study'

'Meeting and learning about new people'.

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Question 3. What aspects of the course did you not enjoy?

In some cases, students found it challenging to balance time for studies with the contact time to attend monthly meeting, especially at the end of the year as final-year projects had to be handed in. Quoted examples of their feedback regarding this question were:

‘Occasional inability to contact and meet with group members’

‘Time-consuming in relation to studies and projects that need to be done for the University’.

Question 4. What topics should be added to the course?

Students mentioned that they wanted more theory on the subject of leadership. Several students also mentioned aspirations to reach out into the community to apply what they had learnt on the programme. Some examples of their feedback were:

‘More role-play to practise handling conflict and workplace meetings’

‘Community group work to learn how to interact with engineers in a public environment and not only on campus’.

Question 5. What topics should be removed (or modified) from the course?

No strong trend could be detected, except for a request to change the selection of case studies. Some of the feedback from students was:

‘The selection of case studies’

‘Have more debates than presentations’

‘Reduce reading material’.

Question 6. What else can be done to improve the course?

Several comments were received from individuals on this question, but the only repeated suggestion for improving the course was to involve more people from other engineering disciplines.

‘Encourage more people to attend the course who are not necessarily Sasol bursars’.

Question 14. What else do you want to tell us about the course or yourself?

Students indicated that they enjoyed the programme, that they found it helpful personally, and that they would recommend the programme to other students. Some commented on the fact that the course was recommendable especially to engineering students because of the skills and views presented. It was also mentioned that the course influenced the way they interacted with others.

‘Extremely useful and many engineering students would benefit from the skills and perspectives presented’

‘I found out things about my personality which I did not previously know’.

Quantitative: Structured questions in questionnaire

Appendix 2 shows the responses to the structured part of the questionnaire that the students completed after the course. From those responses it is clear that students’ perceptions

and skills were changed by their involvement in SELA. Communications, self-awareness, and group work were the constructs in focus and the course was designed to improve knowledge and skills in these constructs.

- ▶ *Communications*—Questions 1, 2, 4, and 5 dealt with communications. Students indicated that their confidence to communicate in small and larger groups changed a lot. They perceived that their ability to effectively communicate by sharing ideas had changed significantly. Students collectively agreed that their presentation skills were enhanced through the SELA programme
- ▶ *Self-awareness*—Questions 3, 7, and 10 dealt with self-awareness. Students indicated that their self-awareness changed a lot and that the assessments done in the SELA programme helped them to understand themselves better. Students also indicated that their personal sense of self was enhanced through the interaction with fellow students and the facilitators in SELA
- ▶ *Group work*—Questions 6, 8, and 9 dealt with groups and teamwork. Students specified that their perceptions of interpersonal skills were enhanced through the intervention. The assessments proved to be helpful to students in understanding other people and fellow students. Most students indicated that even as engineering students they enjoyed working in small groups.

Shadowmatch results

As mentioned previously, students completed the *Shadowmatch* worksheet before the SELA interventions started in February 2013 and again after the interventions in October 2013. The average of the full group on each habit was calculated on both occasions and compared in order to calculate the biggest differences on each habit (see Appendix 3). *Shadowmatch* measures 25 different habits. The group showed significant changes in the following habits (see Figure 3).

Responsiveness is the individual’s reaction speed, in other words the habit of acting immediately if and when necessary (De Villiers, 2009). The average profile of students showed a 10% increase in responsiveness. *To simplify* is the habit of breaking complex scenarios down to linear challenges that can easily be resolved (De Villiers, 2009). Students showed an 11% increase in the habit of simplification.

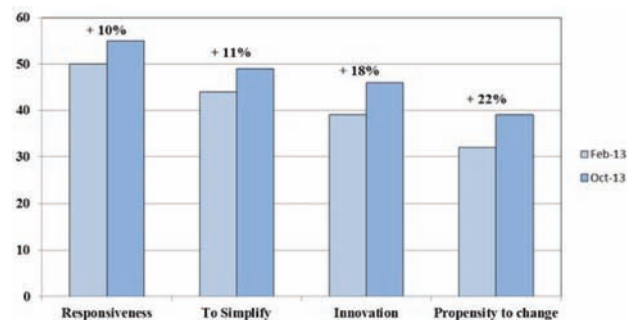


Figure 3—Most significant changes in habits according to *Shadowmatch*

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The most significant shift in the habits of SELA students were on *propensity to change* and *innovation*. *Shadowmatch* (De Villiers, 2009) defines *propensity to change* as the habit of being comfortable with change and the ease with which an individual adapts to new and different things and environments. Students showed a 22% improvement in being comfortable with change after the interventions of SELA. *Innovation* is defined as the habit of finding new ways and identifying better processes and methods to improve on current methods of working (De Villiers, 2009). An 18% improvement in attitude towards innovation was seen in the average profiles between February and October 2013.

How do these relate to the primary objective of improving the leadership elements of self-awareness, oral communication, and cooperative group work? *Shadowmatch* constructs correlate well with some of the National Academy of Engineers (2005) attributes, as mentioned earlier, but the connection with the three elements of leadership under study is tenuous.

Conclusion

For the graduate, a smooth entry into the workplace and confidence to perform built on fundamental leadership skills and capabilities is invaluable; for the employer the graduate is likely to make a more meaningful contribution to improving the company's performance. Employers will reap the profits and individuals will boost their standing in the company. In brief:

- ▶ The responses to the questionnaire showed the strong extent to which skills associated with the three targeted facets had been enhanced by the SELA interventions
- ▶ The positive changes in the *Shadowmatch* profiles on average, particularly in respect of certain habits associated with leadership, are encouraging. The fact that so many individuals showed marked positive changes in habits/behaviour on the *Shadowmatch* results is gratifying
- ▶ Some interventions, like case studies, need to be revisited. Cases with more technical bias might engender more interest and involvement, bearing in mind that the main idea of the case is to stimulate a process of vigorous interaction in the group more than address the knowledge or content aspect of the case
- ▶ The speech and drama intervention to help with self-confidence and making presentations was highly applauded, but probably consumed too much time that could have been allocated to other interventions
- ▶ The fracking simulation was a rip-roaring success and more time needs to be found to do the intervention full justice
- ▶ Too few reflection papers were submitted and more effort needs to be put into persuading participants of the enormous value that can be gleaned from this practice.

SELA, as a pilot study, achieved the objective of showing a measurable change in the three main elements of leadership chosen for the programme. Undoubtedly, these changes can be amplified by giving careful consideration to the composition of the interventions. Shortcomings have been identified in certain interventions that could result in modifi-

cations or, indeed, replacement. Spreading SELA's wings to accommodate more students must be considered. It is abundantly apparent from surveys that there is a healthy demand from students to participate in SELA, although its continuation and expansion is dependent on time, availability of funds, and the capacity of the facilitators.

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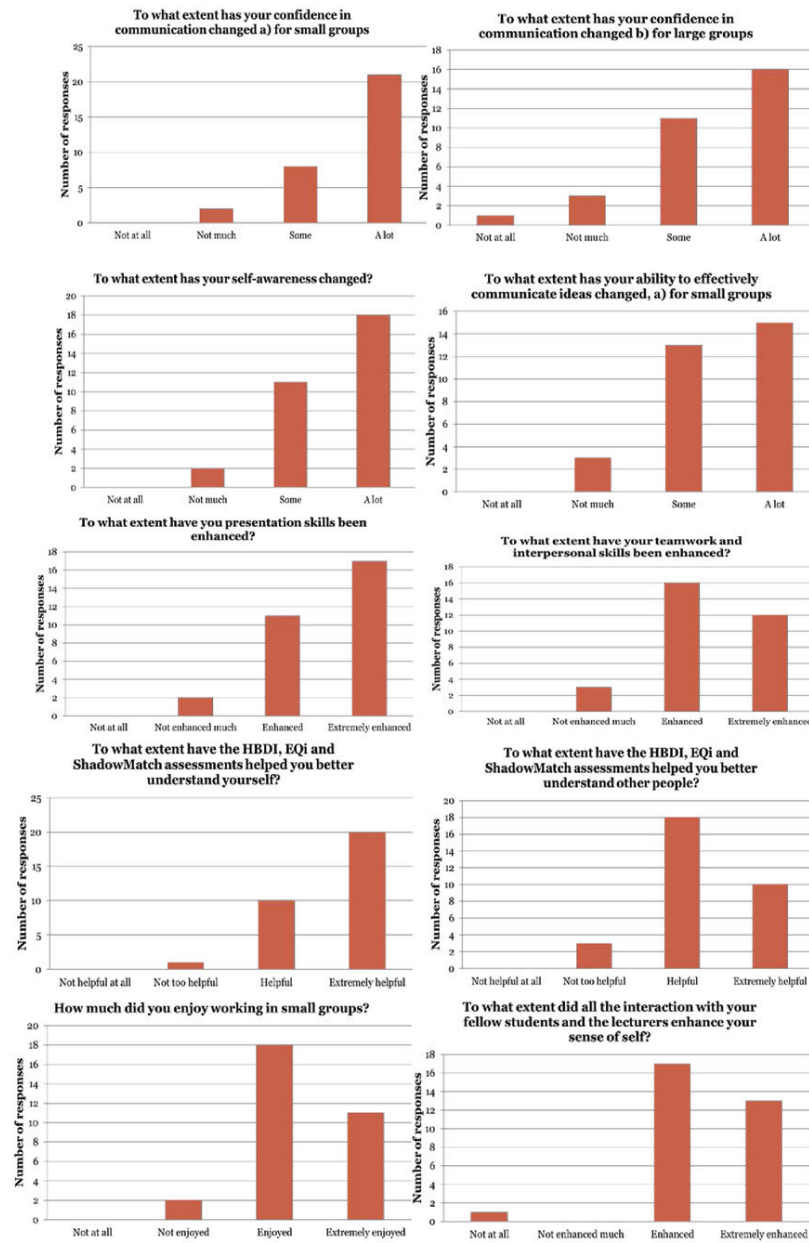
Appendix 1

Programme of modules and interventions

SELA PROGRAMME 2013		
	Contact Times	In between modules
Introduction	Module 1 Three psychometric assessments; discussion on need for non-technical skills. Groups formed.	Group work case study discussion session and coaching session.
	Module 2 Thinking preferences. Full day at Team Building Institute (TBI) Outcomes: Understanding the four quadrants of thinking preferences, your own and others (HBDI).	Group work case study discussion session and coaching session.
Intrapersonal	Individual reflection	
	Module 3 Habits for success. Visiting lecturer (P. de Villiers). Outcomes: Understanding the significance of habits/behaviour (Shadowmatch).	Group work case study discussion session and coaching session. <i>Holiday in the Alps.</i>
	Individual reflection	
	Module 4 Emotional and social intelligence (Eli). Visiting lecturer (Prof. Maree). Outcomes: Understanding the role that emotions play in your associates' lives.	Group work: New groups case study discussion session and coaching session. <i>Through the Looking Glass A</i>
Interpersonal	Individual reflection	
	Module 5 Presentation skills. Visiting facilitators from Speech and Drama. Outcomes: Improving your presentation and other oral skills.	Group work case study discussion session and coaching session. <i>Through the Looking Glass B&C</i> Prepare group presentation on <i>The Fashion Shoe Company</i> .
	Individual reflection	
	Module 6 Presentation skills and exercises. Visiting facilitators from Speech and Drama. Outcomes: Improving your presentation and other oral skills.	Prepare for case studies on <i>Twelve Angry Men</i> and the <i>Fracking</i> simulation
	Individual reflection	
Module 7 Discussion on group functioning. Visiting lecturer. Outcomes: How effective groups function, particularly their handling of conflict.	Group work: New groups case study discussion session and coaching session.	
Individual reflection		
Module 8 A simulation exercise on 'FRACKING'. Outcomes: Hands-on experience of debating and negotiating in multifarious topical issues.		
Farewell brunch gifts and Certificates		

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Appendix 2 Responses to structures questions



Appendix 3 Shadowmatch results

