The value of Experiential Learning – the student perspective

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Abstract – *It is mandatory for all Mechanical Engineering students at the Cape Peninsula University of Technology (CPUT) to do a year of experiential learning in a relevant workplace situation. It is expected that this 12 month period will give students some "real", practical, workplace experience by placing them in situations where they apply the theoretical and practical knowledge acquired thus far, generate new knowledge, participate as a member of an organization and further enhance and/or develop skills. In this way, students engage in and experience the day-to-day activities in a typical work situation. Thus, their level of employability is enhanced and their chances of gaining permanent employment once they complete their diplomas, is increased.*

This workplace experience requires collaboration between the university and the respective workplace in order to provide students with the opportunity to bridge the gap between higher education and the world of work. This paper focuses on senior students' perspectives of the quality and value of experiential learning. It begins with a brief overview of the experiential learning programme in the Department of Mechanical Engineering at CPUT. It then looks at learner feedback with particular focus on their ability to cope with responsibilities in the workplace, skills that are important in the workplace, the universities role in shaping their experiences in the workplace and what they have learnt in the workplace.

Index Terms –*employability, experiential learning, skills, workplace experience*

INTRODUCTION

Graduates that are employable are reportedly a scarcity in South Africa. The "unemployability" of graduates is not endemic to South Africa, yet South African engineering graduates are described, in comparison to German engineering students as, "…not quite as highly qualified…" [1]. This is said to be as a result of their inability to "hit the ground running as they transfer out of their university programme onto the shop floor" [1]. At first glance this statement might seem too harsh a generalization, however there could be some truth in it. A report compiled by the Development Policy Research Unit at the University of Cape Town [2] is but one document that highlights the increasing unemployment rate in South Africa. Of particular concern is the unemployment of graduates. Employers want to employ graduates who are sufficiently prepared for the workplace. It rests on the shoulders of higher education institutions to contribute to the preparation of graduates to assist them in becoming more employable. A document prepared by Higher Education South Africa (HESA) [3] acknowledges the role that higher education can play in contributing to "national growth and development" and indicate that investigations are underway to identifying employability skills required by industry.

In South Africa, one of the key differences between the old technikons (now Universities of Technology) and the traditional universities is the requirement of students to do some form of experiential learning before graduation. The strength of having such a component embedded in a curriculum, according to the South African Technology Network (SATN) [4] is that it enables students to "hit the ground running". Mechanical Engineering students at the Cape Peninsula University of Technology have to complete a mandatory 12 month period of on-the-job, contextualized learning in industry, without which they will not be able to graduate. Essentially, this period provides an important bridge between the world of higher education and the world of work. This period of learning is currently referred to as experiential learning. However, it has been (and in some quarters still is) referred to as cooperative education, in-service training and work-integrated learning, amongst others.

The importance of the period of experiential learning is that it gives students first hand experience of the world of work and affords them the opportunity to participate in the day-to-day functioning of an engineering-related company so that they can gain further, practical insight and apply (where applicable) what they have learned whilst studying. Through this exposure, they can enhance existing skills and recognize which skills they will still have to learn. The experience could foster a deeper understanding of which skills are applicable to which workplaces and which skills are required for performance in which work-related activities. Theoretically it is meant to be an opportunity which blends academic study with work experience which is relevant and conducive to applied learning [4]. El-Raghy [5] asserts that, "Working in an industrial firm for a period during the course of study allows a student to see the real meaning of engineering in a workplace environment". Given the significance of this experience in contributing to the employability of graduates, this paper explores the quality of the experiential learning experiences of senior Mechanical Engineering students. It should be noted that it is not the position of this paper that experiential learning in and of itself renders a student employable.

METHODOLOGY

All experiential learners placed at companies in the Western Cape were contacted telephonically to request their participation in the research. E-mail details were taken upon agreement to participate and a questionnaire, which aimed at exploring student experiences of their experiential learning, was e-mailed to willing participants. To this end the questionnaire contained fourteen, mainly open-ended questions as the aim was to generate qualitative data. Space was provided for students to add comments at the end. Students responded to questions on their experiences thus far, what their main responsibilities were and how they were coping with these responsibilities and what they have learned thus far as a result of their experiential learning.

It should be noted that not everyone who indicated that they would participate, did so. This was the case despite a subsequent reminder and extension of the original date by which the completed questionnaires had to be returned. What is also important is that not all students had access to e-mail at their workplaces and the reason for this given by those who answered the telephone, was that the students were not permanent employees. Another difficulty experienced was that there was no reply at certain companies, despite several attempts on several occasions. Subsequent discussion with the cooperative education officer confirmed similar difficulties with the same companies. In some instances, the students had left the companies and were no longer working there and therefore, not contactable. A total of fourteen responses were received, all from students placed at very different companies in the Western Cape. The student quotations contained in this paper are unedited.

BACKGROUND TO EXPERIENTIAL LEARNING IN THE DEPARTMENT

The period of experiential learning essentially takes place after the student has completed the fourth semester of study. This is as a result of several requests from companies who have felt that the students will have learned more and therefore maximum benefit will be derived from their time in industry if they have already completed all their coursework. Also, should the company feel that their investment in the student has been successful, they would benefit by offering the student subsequent employment as the student would be immediately available to take up the position offered. This link between the department of mechanical engineering and the various industries, where students are placed, has fostered long-term relationships with many companies who loyally and supportively take on students every year.

In the students' fourth semester of study, they complete a series of work-preparedness workshops that are facilitated by the placement officer in the department. The students receive guidance on how to market themselves particularly in their curriculum vitae, in preparation for placement interviews. As students have in the past been reluctant to attend these workshops, it has become credit-bearing and forms part of the assessments in Design. The students subsequently apply for placement by submitting their curriculum vitae to the placement officer who as far as possible tries to match students' strengths with company needs. This is not always possible. The student CVs are then sent to the companies. Interview appointments are set up via the placement officer.

Both students and employers receive guidelines in the form of an experiential learning manual. The manual outlines the outcomes, activities that students should be involved in, company responsibilities, student responsibilities and assessment requirement for the duration of the experiential learning period. Students should be able to demonstrate that they can do the following upon completion of the experiential learning:

- solve problems
- manage themselves and others
- work collaboratively, including responding to organizational structure
- access and use information
- communicate and report effectively, including using computers
- develop practical engineering skills
- apply theoretical knowledge appropriately in practice
- use technology responsibly
- learn from experience e.g. through reflection

Furthermore, it is required that students, under supervision, show evidence of their ability to work independently has developed. Also, to show that they are able to deal with both well-defined and open-ended situations where the courses of action are not well defined.

Some of the company's responsibilities include amongst others: provision of orientation for the incoming learner and provision of supervision and training to the learner by individuals who understand and are interested in co-operative education. The manual also recommends that students be exposed to the following key areas:

- Workplace safety
- Industry standards and regulations
- Fabrication (hand and machine tools)
- Engineering materials
- Metrology
- Maintenance applications
- Process control (manufacturing/production)
- Quality control
- Plant optimization
- Problem solving and analysis
- Inspections and testing
- Design and drawing
- Workplace communication
- Managing activities (own and other)
- Workplace projects
- Planning and control

Learners are required to do one project every six months for which they have to submit a report. In addition, learners have to keep a logbook in which they record their experiential learning performance. These must be submitted to the university. Logbooks, project reports, presentations and skills portfolios are assessed against set criteria and students will have successfully completed their experiential learning upon favourably meeting the criteria.

STUDENT RESPONSES

The following is a report on student responses on their experiences in the workplace.

The workplace

The students' workplaces seem to be varied in type and activity. These include processing plants, various manufacturing companies (each producing very different products), air conditioning and ventilation system installation, companies that deal with safety standards and quality assurance of goods, research centres,

design and manufacturing companies, consulting firms (where project management is emphasized) and textile companies. Thus, the different students will be exposed to very different working experiences and will learn very varied skills (both technical and non-technical depending on what is required in that particular workplace). It also stands to reason then, that some of the technical knowledge and skills acquired at the university will be applicable for some students in some work contexts where relevant. For example, design principles will be relevant for a student who finds himself/herself in a design environment, whilst knowledge of manufacturing (to some extent, depending on the manufacturing processes and techniques used) will be beneficial to someone in a manufacturing environment. A student in a company where products are designed and manufactured will be able to apply both the subject knowledge and understanding of design and manufacturing. In other cases, students may only have theoretical understanding of a process without any practical experience, for example, where blow moulding or injection moulding is done.

Student experiences

The majority of the students were extremely positive and described their experience of working at their companies with great enthusiasm and indicated that their experience was good thus far. The responses suggest that the students' experiences are positive for a number of reasons. Firstly, they are learning (in some cases more than they had anticipated) and gaining experience. Secondly, some students are entrusted with responsibilities that: provide sufficient challenges, foster the realization that learning is continuous, promotes a realization of and an appreciation for the vastness of the engineering field. Entrusting the students with important responsibilities makes them feel valued and boosts their self-esteem as they realize that they are part of a team and need to be depended on. The student responses also suggest that it is important for students to get as much exposure to various on-the-job activities during this period of learning. Keeping students involved in one learning activity for long periods may dampen their enthusiasm and interest to learn.

The students describe their experiences as "fantastic", "eye opening", "interesting", "quite informative" and "so far so good". The student responses also suggest that guidance and support from those they work with significantly contribute to the quality of their experience in the workplace. Students who indicated that assistance or advice is readily available from their co-workers, gave more positive responses than those who did not indicate this. After only three months in industry, the following student responses seem very promising:

"Thus far…has been fantastic. I am involved in decision making, planning, maintenance and project management. The company has faith in my abilities and I have good relationships with everyone."

"Since the start of my in-service training, I have been put to work on my own in order to find my own two feet. I have been put in charge of certain tasks in order to take initiative and responsibility for my actions and am proud to say that I have not failed at any task handed to me yet. I take every day as a challenge and because I am a fast learner, I do a lot of research on the internet…to broaden my knowledge on the specific tasks that I have to encounter. In a nutshell, my only regret is that there is minimal physical work. Also, I have been appointed as a permanent member of staff…about 80% of the time my colleagues , even myself, forget the fact that I am still an in-service student…That makes me feel like a professional engineer already!"

The first quotation is important in that it signals the significance of working relationships and that positive working relationships contribute to positive work experiences. Only one student described the experience with less enthusiasm and was not very positive. The student indicated this by saying: "I've learnt how to work in the workshop with the tools…but I don't feel good…because it's labour work". The student also indicated that the company was the "wrong company" to be placed at. Generally, the amount of manual labour involved in the students' activities and responsibilities vary depending on the nature of the job. Unfortunately, this particular student works for a company where more manual labour is inherent in the nature of the company. The need for less labour or physical work by this student starkly contrasts the sentiment expressed in the previous quotation above, where the student "regrets" the lack of "physical work". This is also an indication of the reality that the work-integrated learning experience cannot always meet all the preferences and expectations of all the students at any given time.

Ability to cope with responsibilities

The majority of the students indicated that they were coping well with their responsibilities at work. These responsibilities vary from one workplace to another and some are more complex than others. They range from, sales, maintenance (also varying in complexity), design, drawings, project management, testing of products and operating machinery. One student describes his/her responsibility as "*jobs that are supposed to be done by students*". This response is very different to those who appear to be treated more as an important part of a team than as only a student.

In some cases the students cope well with their responsibilities as a result of the on-the-job training that is provided. Some students expressed confidence in the fact that their superiors only allow them to move on to a new task or give new responsibilities once the student is ready to perform or take on this responsibility. As one student responded: "*The main reason for coping well is the fact that I am always being monitored indirectly by my superior and he is quite careful not to give me anything beyond my reach*". Other students take the responsibility for coping upon themselves by ensuring that they know or understand what they need to do beforehand. The importance of knowing, having prior knowledge is also an empowering factor for students in the workplace. As two students confidently expressed in the following quotations: "*I first ask for help, and then start rocking*". "*Because I have been given a job I make sure that I understand it first, then if I do face some difficulties I contact the person that gave me a job and ask him. Most of the time I'm coping without even asking because I already know some stuff…*".

Other students' responses suggest that they measure their ability to cope against their past or current performance with responsibilities or duties undertaken. Successful performance is used as an indicator of whether the student is coping or not. One student indicated: "*Because with duties that I have been given, I have been doing well…When I have problems, there are people that I can ask to show me…*". This response suggests that it might be easier for students to cope in the workplace when the environment in which they work is less threatening and more enabling in that they can approach a number of people if problems are experienced. Mentor support seems to play an important role in the students' experiences in the workplace and their ability to cope is improved when they know that this support is available. One student indicates that despite it being "*tough sometimes*", "*…our mentor is always keen to help*".

Student responses also indicate that they are able to cope because they do work that draws on their prior theoretical knowledge. In some cases this makes doing a familiar activity easier than coping with new, unfamiliar work. Unfamiliarity with using certain machinery or inconsistent exposure to certain work were reasons given by two students who claimed to be having difficulty coping. In this instance the students lack confidence in doing because there is not an opportunity to become sufficiently familiar with a particular task. As one student indicates: "*I am struggling sometimes with certain work…with work I do not do a lot…*". Students who are learning need practice to gain confidence in what they are doing. Knight and Yorke [6] emphasise that "learning-by –doing" is an "important source of knowledge growth".

Some of the problems highlighted were that of managing projects and working to tight schedules. The pace of activities in the workplace is faster than what some students are used to. Responsibility for administrative duties such as ordering and dispatching materials, for example, require skills that the students are not yet too familiar with.

Skills that are important in the workplace

Students were asked to list all the skills that they thought important for the jobs that they currently have to do. Communication skills were listed by the majority of the students as an important skill. This was also indicated as the skill that needed improvement. The second most listed skills were tied between computer skills and manufacturing skills. Communication skills fall into the category of skills popularly termed as "soft skills". These skills are sometimes termed "key skills" or "core skills" as referred to in Bennet, Dunne and Carré [7] "generic skills" or "process skills" [8]. The technical nature of mechanical engineering has traditionally created the perception that skills like communication are not as important as technical skills. An unequal juxtaposition of the two skills sets is implicit in the traditionally technocratic approaches to engineering. Thus, the perception with many new students in the Department of Mechanical Engineering is that the ability to communicate effectively is of secondary importance until they have their first experience with the world of work.

In a paper exploring the views of a cohort of fourth semester mechanical engineering students of "soft skills", it was noted that students who have work experience (through experiential learning or prior employment) understand the importance of these skills and how they are complementary to the "hard skills" [9]. This realization is evident in the following student responses: "…*communication skills (very important even though I never took it serious at tech*…). "*I've realized the importance of team work, communication skills. You should be in a position to communicate your view/opinion in a manner that it is clear to everyone your working with because miscommunication might just put you in big trouble and it is essential…*"

Despite the fact that engineering curricular are known to inherently downplay the importance of "soft skills" particularly in relation to technical skills, the reality is that the skills that are downplayed are what contributes to the marketability of graduates. In addition, and equally important, is the fact that the global trend is that employers generally desire to employ graduates who have a healthy balance of skills. A lack of appropriate skills could result in unemployed engineering graduates [10]. Bennet, Dunne and Carré [7] emphasise that higher education should be mindful of the development of core skills and recognise their role in developing these critical skills.

Department of Mechanical Engineering's role in the student experience

The majority of the students indicated that the department of mechanical engineering had prepared them sufficiently for the workplace. Many emphasized the role the department played in providing them mainly with theoretical knowledge, which they can now apply. However, reference was made to a lack of practical, hands-on exposure. As one student indicates: "*The mechanical engineering department prepared me well with theory needed, but not well with the practical education like working the machines*".

It is interesting to note that student satisfaction with the department's role in preparing them for the workplace is linked to whether they are currently struggling or not. A positive experience in the workplace was generally reflected in positive responses about the department's role in this experience. The responses suggest that if the student experiences difficulty in the workplace, then this reflects negatively on their recollection of the role played by the department.

Some students reflected positively on how their involvement in the integrated project has contributed to preparing them for the workplace. The integrated project is offered at all levels of the mechanical engineering diploma and is focused on providing students with the opportunity to learn to work in a group towards a common goal in finding a solution to a design problem (in most cases) within a specified period of time.

The responses also point to how some students have already taken responsibility for their own learning and independent reflection, which is important for lifelong learning. When these students feel that they are not prepared to handle a particular task or responsibility, they know that it is important to find out through asking (as earlier responses suggested) or by doing independent research. One student's response refers: "*Sometimes it just takes a little sit down to think and call back faded and rusted knowledge and sometimes an old textbook needs to be consulted*".

Those who indicated that the department did not sufficiently prepare them for the workplace did so without providing justification for this that directly related to the department, but more to the situation within which they currently found themselves, for example, being unhappy at the company or that the work that they do requires skills other than those directly related to mechanical engineering, for example accounting. This in itself is interesting, especially within the context of media reports about the unemployment of South African graduates and how this is linked to skills mismatches, particularly in the case of engineering graduates [10]. Barnes [11] refers to an HSRC report which indicated that a large number of engineering professionals were employed in the business and finance sectors where their engineering skills were not put to use

A student who responded with ambivalence said: "*The one thing I have learnt you can not prepare for work it is almost impossible to contemplate it even if you have studied*". This sentiment emphasizes the significance of experiential learning for engineering students. Workplaces are varied in so many ways that the impossibility of knowing what it is like, as expressed by the student, can only be experienced when students are placed in a real work context. Despite the preparation, which should not be discounted in any way, the actual experience is where the real learning takes place. This is congruent with the notion expressed earlier in this paper, of learning by doing.

The students' suggestions as to what the department could have done to better prepare them for the workplace are directly related to their realizations as a result of their current workplace experiences. The suggestions include the provision of greater exposure to practical manufacturing experience in the workshop. Currently, the diploma students have limited, dedicated time in the workshop only during their first two semesters of study when they do a subject called Manufacturing Engineering.

It was further suggested that the department give students more projects to do as the one integrated project per semester is appreciated, but more experience will better prepare students for managing projects in the workplace. Again, the suggestions were specific to the current work situations within which the students find themselves. Those who are required to do work related to finances, suggest that the department include aspects of finance and accounting in the curriculum, for example. Another student who now realizes that the subjects that were not chosen during the period of study and are now important, regrets not having done those subjects, and suggests that all subjects offered be compulsory.

Learning that has taken place

Some of the students' lists of what they have learned are limited and might not reflect all the learning that has already taken place as in many instances students are still identify learning with what they are able to do with their hands, like operating a machine or sharpening a drill bit. This does not perhaps reflect the deeper levels of learning that are expressed in their previous responses. However, other students show that they are able to recognize their learning of both the technical and the non-technical aspects. In most cases students have learned much during their short time in the company. The learning that has taken place thus far reflects that students are, in most cases, being exposed to those areas of learning outlined in the experiential learning manual (referred to earlier in this paper). For example, students refer to issues of safety that they have learned, working with various machines, working in teams, maintenance and problem solving.

One student response shows that the student has the ability to make links between prior learning and to enhance existing skills, "*I learnt many things, especially in designing and drafting, and I also picked up little bit of manufacturing skills and communication skills too, added to what we have learnt and practiced at Mechanical Department*". Overall, the responses suggest that the experiential learning is an invaluable learning opportunity for students.

CONCLUSIONS

It can be concluded that the experiential learning is an essential part of the Mechanical Engineering curriculum at the Cape Peninsula University of Technology and an important link between industry and the university. The students who are placed at workplaces in the Western Cape do their experiential learning at very different companies. Wherever the student is placed, it will be a necessity for that student to adapt to the "culture" of that particular workplace. It would appear that the majority of the students have thus far succeeded in blending into their new and different environments.

The experiential learning experiences are generally expressed in very positive terms and suggest that the companies at which students have been placed are sufficiently interested in the students and their learning. At least two students indicated that they have already been offered permanent employment at their companies. This speaks to the fact that these students must already, in the short period of time, have demonstrated their employability. In general, only two students expressed dissatisfaction.

The students seem to be coping well with their responsibilities and are managing the pressures that are implicit in many work contexts. Also, the companies do not appear to give students responsibilities, however, some caution is exercised in not giving students more than they are ready to handle. This is so in most cases. In cases where students are exposed to situations that they are not ready to handle, the students have confidently expressed that they ask, in addition to finding out from other sources. In this way, the students demonstrate a level of independent learning.

The student responses also show an awareness of the skills that are required in their various workplaces and it is encouraging that many of them have realized the critical importance of both technical and non-technical skills. This is particularly important, if they want to be successful in securing employment.

It would appear that the education given by the Department of Engineering is adequate in providing students with the basis skills to get by in the typical engineering workplace. Some students did, however indicate that they could have been better prepared and could have been given greater exposure to working with machines in the departmental workshop, for example. The reality is that there is always room for improvement of teaching and learning. At the same time it would be an unreasonable expectation for any single department to produce students who know everything and who are absolutely ready for any workplace environment.

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