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SHIFTING SPANNER OR SHIFTING EXPECTATIONS – AN APPEAL TO  
ENGINEERING COMPANIES



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#### ABSTRACT

Learners reading the National Diploma in Mechanical Engineering are required to successfully complete two semesters of monitored experiential learning, P1 and P2, in order to graduate. In particular, P1 is concerned with gaining competence in basic engineering skills i.e. use of hand tools, filing, sawing, drilling, tapping, turning, milling,

grinding, welding etc. The majority of today's learners have little or no previous experience in such things. They have not had the opportunity to use simple hand tools or work on and maintain common machinery such as lawn mowers and bicycles. However, many companies expect their prospective P1 learners to have already developed some of these skills and base their selection criteria on this pre-requisite.

A case study will be presented by means of an interview with a human resources manager who saw beyond inexperience and immaturity and allowed learners from a disadvantaged background the opportunity to engage in experiential learning and bloom.

Brief discussion and comment from the audience is invited.

## INTRODUCTION

The typical, traditional learner mechanical engineer is one who at an early age discovered a fascination with mechanical objects, which sometimes led to him getting into great trouble. An example of this would be giving in to the temptation to take his parent's alarm clock apart and being unable to put it back together. As he grew older, his bicycle was also meticulously stripped and partially reassembled except for a jam jar full of assorted nuts, bolts, bearings and circlips that were now somehow surplus to requirements. Worse still, the lawn mower suffered a similar fate. To keep him away from household objects, his father would buy him Lego or even Meccano, if he was especially fortunate. He would build model aircraft from kits and learn to read the assembly instructions and make little sketches of modifications he made to the elastic-band motor. But during this time, through aptitude and application, a liking developed for working on machines and often under his father's guidance, he became competent in the use of a hammer, saw, screwdriver, spanners and basic hand tools. He was able to crawl under the car and identify and remove the oil change drain plug, even selecting the correct spanner. By the time he gets to High School, he enjoys technical drawing, woodwork and metalwork, and it becomes a natural choice to apply for an apprenticeship in engineering at the company his father worked for. Of course, he is accepted.

Enter the 21<sup>st</sup> century. Today's prospective mechanical engineer comes from a simple home, possibly in the rural areas, where the alarm clock runs off a battery and is rather uninteresting inside, just a black box with a few wires. His or her father travels by train and taxi and has never owned his own car. Her brother's friend owns a bicycle. She studied hard at school and obtained good grades in maths and science. She has noticed that there is a great deal of encouragement in the media to pursue a career in science and technology. She believes there is a good future ahead in engineering and so makes application and is accepted at a far distant Institute of Technology or Comprehensive University. The diploma course consists of four academic semesters and two of

experiential learning, P1 and P2. P1 is about learning basic hand skills, filing, sawing, drilling, tapping, measuring, grinding, turning, milling, welding and so forth.

Surviving S2, her thoughts turn toward P1 and thus begins a cycle of application and regret correspondence. Rarely is the opportunity to attend an interview granted. And then one day, an invitation is received to undergo psychometric testing with a large multinational company. The results give the company confidence to extend the invitation to a second interview, this time facing a panel of experts. If successful, she will have the opportunity to undergo P1. A critical part of the selection process looms. One of the interviewers asks her to describe a shifting spanner, so she explains that it is an adjustable tool that can fit different sizes of nuts and bolts. Knowing that the use of such a tool is open to horrible abuse, the interviewer asks when should it be used and when should it not. At this point, our budding engineer's future is hanging on a satisfactory answer to this problem. Having never actually held and operated a shifter, she is unable to answer and concedes "Sorry, but I don't know."

The selection interview is over. Summing up the candidates, she is passed over as one who "Doesn't even know how to use a shifting spanner!" Clearly, she will never cut it in the world of mechanical engineering.

The irony of this decision is that the whole purpose of P1 is to impart the basic hand skills that the learner does not have, and this lack of experience has now disqualified the learner from having the opportunity to gain that experience! It is a "Catch 22" situation, that really should not be. Companies need to acknowledge the background of our 21<sup>st</sup> century learners and adjust their entry level expectations and requirements accordingly. In other words, remove the shifting spanner and shift expectations. After all, the P1 programme is the same whether the learner comes from a traditional background or belongs to the new reality. Just allow the learner the opportunity to gain that vital and necessary experience by engaging in P1.

## INTERVIEW

Melissa Munava is the human resources manager with a manufacturing company in Boksburg, which provides automated solutions, using hydraulics, pneumatics and process. The company has supported the P1 and P2 experiential learning programmes for several years and many learners have successfully passed through the workshops and technical departments. This semester past, two black females were selected for P1 training. Here follows an interview with Ms. Munava concerning her selection processes and training.

A. Please explain the process you use in selecting suitable candidates for experiential learning.

M. Experiential students should obviously not be assessed and interviewed in the same way as normal staff. The difference is that in your usual staff you will normally look for qualifications, experience and the competencies that indicate a good fit to the job and environment. With students, however, all you have are the academic qualifications with no experience whatsoever. A closer look (in the limited time made available for an interview) at the behaviour competencies, inter-personal, thinking competencies and so forth, combined with thorough reference checks with their lecturers and other such people, will result in a clearer picture of what the student is made up of. It works well for our company! We interviewed seven students as a panel, and chose only two. Both students were very confident of themselves and of their capabilities, and they displayed a hunger to learn that was not evident in any of the others.

A. Describe for us the two successful candidates.

M. Learner #1 is a very feminine young woman. She does not have what you might imagine as the typical appearance of an engineer, or any person that could handle manual work. She has had no prior exposure to anything technical save for the knowledge gathered at school and college.

A. How strong is her academic record and what personality strengths or qualities did you identify?

M. Her academic record is quite impressive compared to the other applicants. She has three S4 subjects still outstanding and has obtained four distinctions including one in mathematics. Upon speaking to her it was evident that she has a drive to succeed and a passion for engineering that is born out of interest and a desire to go out there and “make her mark”.

A. And Learner #2?

M. Learner #2 has completed S4 although her academic record is not as good as the other students. However, upon interviewing her, an uncommon intelligence and determination is evident. She has a very strong personality, which if taken at face value would put off many interviewers as she comes across as being rather abrasive.

A. Why did this not put you off?

M. She wants to get into engineering and she will do so whether we give her this opportunity or not, and our feeling is that we should play a part in moulding and contributing to her obvious talent.

A. Looking back, how did the other five candidates compare?

M. By comparison, the other five students were clearly there by default, with no passion for engineering. By their own admission engineering was now ‘the’ profession of

choice and females particularly had a better chance of getting employed. It had nothing to do with what they really wanted to do.

A. How did you prepare the learners for the workplace?

M. Both students were orientated quite extensively to the company as a whole, but more specifically to the workshop and industrial environment. In their first week of employment at our company, the students went through a general induction where they learnt the history of the company and our general industry, our rules and regulations, our business times, our code of conduct, dress code, health and safety regulations and so forth. Thereafter they had a tour of the workshops, were taught about the safety aspect and requirements, including firefighting. They were introduced to workshop tools and machines. Authority levels were explained as were the reporting structures.

A. And I understand the workforce was also prepared for the introduction of the learners.

M. Yes. Our industry, indeed our very company is male dominated. It was therefore the first time females had worked in our workshops. Separate change rooms had to be prepared for them, and a meeting was called by the human resources manager together with the relevant line manager for each department. The staff were advised that the students were coming on board. The staff were all spoken to concerning acceptable and unacceptable behaviour. Sexual harassment and the implications were explained and discouraged. All this was done in order to get buy-in from the work-force, to provide the students with the best possible mentorship and training. It became each man's responsibility to teach as best as possible and to take ownership of the process and therefore the results. The students were advised in the same way, and dissuaded from engaging in any improper relationships.

A. Coming to the actual P1 programme, how was this put together?

M. We followed the experiential learning guideline as supplied by the institution (see appendix). The learners passed through the various departments, including inspection, assembly, machining, electrical as well as spending some time at various sites where the company's products are used.

(A brief explanation is required regarding the monitoring of the learners. This is achieved by means of a logbook and mentor system. The various activities are recorded chronologically and evaluated by the mentor. Space is provided for the mentor to make comments relating to the progress of the learner.)

A. And what about the use of hand tools, for example the shifting spanner?

M. This was done on-the-job in the assembly bay. They worked along with artisans who provided the necessary instruction. For example, these learners now know when to use and not to use a shifting spanner!

A. What comments did the artisans make about the learners?

M. That they were quick to learn. Dedicated. Showed great interest in how cylinders operate. Helpful. Able to assist on site and well received by customers. Did not complain even when returning from site late. Asked good questions. Prepared to go the extra mile.

A. How were the learners introduced to machining operations? What exercises were they given?

M. Under supervision and after safety training, they were supplied with a full set of drawings of a basic, small hydraulic cylinder. They had to select the correct materials from the stores and machine the parts from scratch. Finally, they assembled the parts together. This included processes such as turning on the centre lathe, milling, grinding and honing.

A. That is an excellent exercise, as the process from design through to finished product becomes apparent.

M. The learners also spent some time in the drawing office, although this will be addressed in greater detail during P2.

A. What was the outcome for the two learners at the end of the period of P1?

M. At the end of her P1 semester, learner #1 had gained the respect of the workforce, including that of a particularly difficult artisan who operates in a very specialized field. Up to this time, he had refused to train or work with anyone either brought to him or identified in the company's succession plan. When asked why he chose this young black woman out of the many other learners and employees of all races and backgrounds he had rejected, he stated that she was 'not stupid', willing and eager to learn, and above all she had an aptitude for the work that he had not come across yet in anyone.

A. And learner #2?

M. After assessing her work and going through the reports of all those that she worked with, the comment made by our technical divisional manager was that he would not have expected her to know what she knows now, even if she had spent a year with us. He said: "(Learner #2's) presentation of her practices at (our company) was presented very professionally; her knowledge of each section was above my expectations. I was very impressed by her understanding of how each section relates to our total operations. (Her) interest in what we do was reflected by her knowledge of the IMS lube units, not only did she explain the operation of the units, but she also understood how this worked on the Kawasaki cone crusher. (This is the learner with the less impressive academic record.)"

## CONCLUSION

The positive outcome experienced with this East Rand company is neither unique nor by chance. The selection philosophy is important. In our interview, we noted that experiential learning candidates cannot be assessed in the same way as normal staff. They are short of the experience that leads to competency, but that is the whole point of engaging in experiential learning.

Over the past 6 years, approximately 300 mechanical engineering companies in the Gauteng area have experienced similar results. Many of these learners have gone on to find full time employment with the company after P2 and some have moved up through the ranks on the way to becoming senior members of staff. Of great value to retaining learners is a clearly defined career path.

The value of experiential learning can be noted in comments recently offered by students. One female underwent training with a large construction company. On occasion, she had to stand up and confront her manager in order to obtain the correct training in line with the institute guideline. After spending some time in the drawing office she said:

“I’ve realized that “spoon feeding” leads you nowhere and you end up understanding nothing. Therefore, finding your own way out of a battle helps and it improves your designing abilities.”

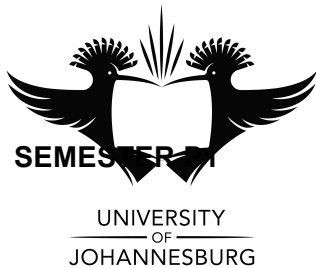
A male student underwent P1 training at a company manufacturing fasteners used in the mining industry. It is a particularly challenging and demanding production environment. He made these observations:

“As students, when we get into industry we tend to become “stupid”, not that we are, but because we are overwhelmed by the environment that we are exposed to. We find ourselves in a position where we have to follow people around so we can learn from them, while at school we are used to sitting and waiting for a lecturer to come and teach. For a successful training, it is entirely up to the student to make sure they participate in all activities which are set in the programme and work together with the relevant people in the specified section.”

These comments help to underscore that the outcome of experiential learning is a huge maturing process for the learners. It provides them with the necessary skills needed to become competent engineers. This does not only include hand skills, but life skills too. Companies need to adjust their expectations of inexperienced learners and allow the P1 process to do its job.

“All We Are Saying, Is Give P’s A Chance!”

APPENDIX



DEPARTMENT OF  
MECHANICAL ENGINEERING TECHNOLOGY

## EXPERIENTIAL LEARNING GUIDELINE

National Diploma: Engineering: Mechanical

Programme Code: 293-3

Basic Skills	Period
(Weeks)	
1. Safety - general	1/2
2. Measuring techniques and instruments	1/2
3. Hand tools and bench work	3
4. Turning	3
5. Milling	2
6. Specialised machining	1
7. Welding and plating or sheet metal work	1
8. Basic electricity	1
	<u>12</u>
Goal Orientated Learning	
1. Bearings - types, mounting and fitting	1/2
2. Couplings - types, fitting and alignment	1/2
3. Drives - types, alignment	1/2
4. Lubrication - systems, application	1/2
5. Brakes and clutches - types, application	1/2
6. Valves - types, construction, application	1/2
7. Pipelines - water, steam, oil, air, etc.	1/2
8. Keys - fitting of	1/2
9. Pumps - types, construction, mounting	1
10. Industrial exposure - visits to plants/factories	1
11. General maintenance and/or manufacturing and/or construction	6
	<u>12</u>

SEMESTER P1  
(In More Detail)

Basic Skills

1. Safety
  - Safety rules and regulations
  - Wearing of safety equipment
  - Safe use of hand and machine tools
  - Care of hand and machine tools
  - Safe conduct in the workshop
  
2. Measuring techniques and instruments
  - The construction and application of:
    - Marking-off and measuring instruments and accessories
  
3. Hand tools and bench-work
  - Description, care and application of:
    - Saws, files, drills, taps, dies, reamers, etc.
    - Description, care and application of drilling machines, bench grinders and power saws
  - Projects entailing: marking-off, sawing, filing, measuring, drilling, tapping, thread cutting, etc.
  
4. Turning
  - Construction, accessories and care of a lathe. Types, applications, grinding and cutting speeds and feeds of cutting tools.
  - Projects entailing parallel and taper turning, facing, centring, screw cutting, drilling and boring.
  
5. Milling

Construction, accessories and care of a milling machine

Types, application and cutting speed of cutters

Projects entailing the machining of: a slot, a slit, square faces, matching components, etc.

6. Shaping and specialised machining

Description, application, operation and care of machines, unique to or essential for the activities of the employer, i.e. spark erosion, engraving, CNC machines, etc.

7. Welding, plating or sheet metal work

Principles, operation and application of:

Oxy-acetylene welding and electric arc welding

Weld preparation and selection of flux, filler material and electrodes

Construction and operation of:

The guillotine, bending machine and portable machines

Projects entailing all machines and processes listed above.

8. Basic electricity

Principles of operation and application of electrical measuring instruments

Single phase circuits, transformers and motors

Conductors and cables - application and joining

Three phase circuits, transformers, motors and starters

Projects entailing wiring, joining, testing and fault-finding

### Goal-orientated Learning

#### Items 1 to 9

The goal of this period of learning is to familiarize the learner with the most common basic mechanical components and assemblies. The strip/remove and assemble/mount processes expose him/her to the application, proportions and functions of components and assemblies as well as the level of skill required to perform the tasks. The degree of difficulty and responsibility must be increased as the learner achieves greater skill and proficiency.

10. Industrial exposure

Visits to plants or factories provide exposure to industrial processes and systems as opposed to components and assemblies i.e. the function of sub-systems in the process or system. Learners should submit reports indicating their observations.

11. General maintenance and/or manufacturing and/or construction

As a member of the maintenance and/or manufacturing and/or construction team, the learners will gain experience with and develop an appreciation for the functions of components and assemblies.

## SEMESTER P2

Overall Objective:

Period: 24

weeks

On completion of the programme the learner should have a basic knowledge of:

1. The organisational structure of the Company;
2. Plant layout;
3. Plant operation;
4. Maintenance and/or manufacturing and/or development and/or construction, etc. procedures; and
5. Drawing office procedures.

Sections 1, 2 and 3 could be completed as assignments or projects.

For sections 4 and 5 the learner must be a member of for example, the maintenance team and/or the draughting team. Individual assignment projects should be used to complement team activities. For Section 4, experience should be gained in about 2 or 3 of the work activities mentioned.

Note:

The learner must be allowed to increasingly exercise his/her own judgement and improve his/her decision-making ability.

For each project, the learner is expected to:

1. Collect information from all parties concerned;
2. Make own observations;
3. Study all relevant and available literature; and
4. Submit a written report to the trainer or mentor.

Each project should be completed within the allocated time and the report should highlight:

1. Problems identified - What have I done?  
- What have I learned?
2. Possible solutions - What can I suggest?