

# The Experience of Education Students in the Technolab.

## Do Engineers and Educationalists have to co-operate?

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### ABSTRACT

The purpose of this study was firstly to explore and describe post graduate students' experiences of Technology Education in the TechnoLab and secondly to deduct recommendations to assist and facilitate the learning process of students in the TechnoLab. The research design can be described as qualitative, exploratory, descriptive and contextual. Twenty-eight post graduate students in Technology Education participated in a workshop at the TechnoLab for one morning session. The aim of this workshop was to expose them to the so-called technological process, which they had already studied theoretically. After participating in this workshop students were requested to write down their experience of Technology Education in the TechnoLab. They were then divided into three focus groups for interviews conducted by three moderators. The same

question was posed to each group: "How did you experience Technology Education in the TechnoLab?" These interviews were audiotaped and later transcribed. Tesch's method of analysis was applied to the data by three researchers independently followed by a consensus discussion. Three major themes were identified from the data, namely the TechnoLab and Technology Education were conducive to learning; fear and anxiety were experienced in the unknown situation, that is the TechnoLab and Technology Education; and empowerment through exposure to the TechnoLab and Technology Education. Further categories were identified within each of these three themes. Recommendations are made to assist and facilitate the learning process of these students in the TechnoLab.

The aim of this investigation is:

- to explore and describe post graduate Technology Education students' experience of Technology Education in the TechnoLab; and
- to suggest recommendations for assisting and facilitating the learning process of these students in the TechnoLab

### INTRODUCTION

Technology Education is still in its infancy in South Africa. Except for a few NGO's, institutions for Higher Education have not really become involved in teacher education programmes for Technology Education.

Since 1995 the Rand Afrikaans University (RAU) has initiated two post graduate programmes, namely a M.Ed and B.Ed in Technology Education. RAU has also taken the initiative to establish a Centre for Technology Education. The aim of the Centre is to promote Technology Education both at national and international level through research, instruction and community service.

One of the facilities that is part of the Centre, and which has been in operation since March 1995, is the RAU TechnoLab. The TechnoLab falls under the auspices of the Faculty of Engineering and aims at creating technological awareness among school learners and teachers.

The instructional model followed in the

TechnoLab is constructivist in nature. The TechnoLab extensively uses LEGO DACTA sets to address a variety of technological problems. Learners have to solve the given technological problems by building a model with the available LEGO DACTA sets. The LEGO DACTA sets that are being used in the TechnoLab consist of components such as small electric machines, control systems, structures, levers, gears, pulleys, energy systems. Although the focus is on learning in a fun way, the links with real world problems are always emphasised.

### PROBLEM STATEMENT

Because Technology Education is still in its infancy stages little or no research has been conducted to assess learners' experience concerning Technology Education and exposure to the TechnoLab. Against this background the following questions arise:

How do post graduate students in Technology Education experience Technol-



**Research Article**

ogy Education in the TechnoLab? What recommendations can be made to assist and facilitate the learning process of these students in the TechnoLab?

## AIM

The aim of this investigation is:

- to explore and describe post graduate Technology Education students' experience of Technology Education in the TechnoLab; and
- to suggest recommendations for assisting and facilitating the learning process of these students in the TechnoLab.

## RESEARCH METHODOLOGY

The research design was qualitative, exploratory, descriptive and contextual (Mouton & Marais, 1991:43-44,51). Spontaneous (naïve) sketches and focus group interviews (Kingry, et al., 1990:124-125; Kreuger, 1994:16-20) were conducted to ascertain post graduate students' experience of Technology Education in the TechnoLab. Themes were identified and recommendations deducted to assist and facilitate the learning process in the TechnoLab.

**Sample** The population consisted of all 28 post graduate students enrolled at the Rand Afrikaans University during the first semester (February to June 1998) for the Technology Education A module. All the students were included in the sample.

**Methods to ensure trustworthiness** Guba's (Lincoln and Guba, 1985: 192) model for trustworthiness was utilised to ensure the trustworthiness of this research. The four criteria for trustworthiness, namely truth value, applicability, consistency and neutrality were applied. Using the criterion of truth value, strategies for ensuring credibility were applied. Strategies for ensuring transferability were applied based on the criterion of applicability. Consistency was ensured by strategies of dependability and neutrality by strategies of confirmability.

### Data collection

Twenty-eight post graduate students in Technology Education participated in a workshop at the TechnoLab for one morning session. The aim of this workshop was to expose them to the so-called technological process, which they had already studied theoretically. Firstly as a resource task they were familiarised to the practical aspect of gears. Secondly, as a capability task they were given a technological problem where they had to incorporate gears as part of the solution.

After participating in this workshop students were requested to write down their experience of Technology Education in the TechnoLab. They were then divided into three focus groups for interviews conducted by three moderators. The same question was posed to each group, namely "How did you experience Technology Education in the TechnoLab?" The moderators facilitated the interviews by creating an open, non-threatening atmosphere. These interviews were audiotaped and later transcribed. The moderators made field notes (observational, theoretical, methodological and experiential) directly after the interviews as a triangulation method (Wilson, 1989:436-438).

### Sample realisation and analytical procedures

Data was saturated as evidenced in repeating themes after the analysis of 28 naïve sketches and three transcribed focus group interviews. Each focus group consisted of eight respondents. Tesch's method (Creswell, 1994:154-155) of analysis was applied to the data was analysed by three researchers independently followed by a consensus discussion.

## RESULTS AND DISCUSSION

Three major themes were identified from the data, namely the TechnoLab and Technology Education were conducive to learning; fear and anxiety were experienced in the unknown situation, that is the TechnoLab and Technology Education; and empowerment through exposure to the TechnoLab and Technology Education. Further categories were identified within each of these three themes. The various themes will now be discussed in greater detail with supporting direct quotes from the naïve sketches and focus group interviews.

### The Technolab and Technology Education Learning Environment were Conducive to Learning

Students identified different categories of experiences during their session at the TechnoLab which indicated that they found their exposure to Technology Education enriching. These experiences included the tutor's approach to education, being involved in teamwork and the hands-on learning approach. These three categories will now be discussed with supporting quotations from respondents' written naïve sketches and from focus group interviews.

### The tutor's approach to Technology Education and the creation of an environment conducive to learning

Respondents referred to the tutor's attitudes, behaviour and method of creating a learning environment as contributing to creating a context conducive to learning. The following quotations support this:

*"...die tutor was baie vriendelik en het hom goed van sy taak gekwyt"* (the tutor was very friendly and did his job well).

*"...sy hantering van die groep was gemaklik, dog gestruktureerd, dus het ons die heel tyd geborge gevoel, want ons het geweet wat om te doen."* (his handling of the group was relaxed but also structured, so we felt at ease the whole time because we knew what to do).

"I was put at ease when ...told us there is no right or wrong, your system either works or not"

*"...the welcoming approach of the facilitator...made me feel at home. I started looking forward to work and tackle any task that was to be given to me. I was excited by the manner of explanation and introduction approach of the gears."*

"The presentation of the method was very simple and clear. Everybody knows what to do from the beginning."

"My experience is that the environment in the lab was warm, so I thought everything we are going to do is easy."

"The facilitator was good on his work. Interacting well with the trainers. All people were being taken from the known into the unknown. Exploration was the name of the game. This made participants to feel confident and brave in solving tasks...In the process freedom was there to critically and creatively think and analyse issues."

From these quotations it is clear that the respondents experienced the tutor as friendly and that his management of the group was relaxed but also structured. His presentation of the method was simple and clear; and everyone knew what was expected from him or her. Respondents said that they had the opportunity to explore different ways of addressing the assignment. All this contributed towards setting an environment that was conducive to learning.

During this workshop students did not receive direct instruction but were guided to discover how new ideas relate to each other and to existing knowledge. The literature supports the important role of the teacher to create a learning environment conducive to learning. A teacher can manage by giving up control ... by striving for partnership in leading learning and by reducing some of the

'teacher talk' (Litterst & Eyo, 1993:280). This implies that the teacher should rather play the role of facilitator (Wheatley, 1991:18; Young, 1992:53; Biehler & Snowman, 1993:424; Hunter, 1993:108; Wolk, 1994:44; Shield, 1996:12), and thus provide opportunity for the development of creative and critical capacity (Soriano de Alencar, 1993:94).

### Being involved in team work

Respondents experienced their involvement in teamwork to complete the assignment as positive. **The contribution of all the team members assisted them to find answers to questions.** The following quotations highlight this aspect:

"...team work was effective since we pooled our ideas and came up with the best possible solution."

"The experience was fun while we learn to use different processes to solve problems and worked in a co-operative environment."

*"Ek was bevoorreg om in 'n baie aktiewe en lewendige groep te werk wat die oggend baie leersaam en aangenaam gemaak het."* (I was privileged to work in a very active and lively group that made the morning very educative and pleasant)

"I could see the importance of co-operative and collaborative learning, because it was like one person came up with a problem and the other members evaluated and refined it."

The literature supports the shared responsibilities of the team members towards one another in the sense that they feel responsible for one another and have everybody's interests at heart (Perkins, 1994:84; Gunter et al., 1995:224). One of the dynamic principles of group work is the fact that students tutor each other, and improved learning is actually achieved by that (Fogarty & McTighe, 1993:167; Secules, et al., 1997:58; Slavin; in Gunter et al., 1995:222).

**They also experienced a sense of security in working in a team.** The following quotations support this experience:

"Being part of the group and contributing towards problem solving was a fantastic event...Each time I encountered a problem my partners were there to help me. It made me feel comfortable because I was at first confused about what was to take place in the lab."

"By working in a group I felt slightly less threatened by my lack of technical knowledge - there is a lot to say for co-operative learning."

"...when you are in a small group situation you feel secure to be able to express

yourself and give of yourself without fear that you are making a mistake or find you incorrect or something."

The sense of security caused by the positive interdependence of students working in a group is also supported by the literature. Students support one another in the sense that work is divided and they need to feel and believe that their success is dependent on the success of the whole group. (Sternberg, 1985:198; Redding, 1990:47; Young, 1992:50; Biehler & Snowman, 1993:526; Perkins, 1993:29; Hartman, DeCicco & Griffin, 1994:47; Gunter et al., 1995:224; Woolfolk, 1995:377; Brombacher, 1996:28; Freedman, Calhoun & Altemus, 1996:79; James, 1996:87; Paul & Elder, 1996:2; Wakefield, 1996:531; Secules et al., 1997:58).

**The fact that there were several teams contributed to a sense of competition that also assisted them in the process of completing the assignment.** The following quotations are examples of the respondents' experiences in this regard:

"I think one thing that forced me to be more creative was (uhm) there was a sense of competition in the room. I mean the different groups, they are working with the same material, the same stress, the same specification, the same time and they must come up with the best."

"Ja because deep inside we are all very lazy and when we are given such a (laugh) big thing to do we will just do it to finish, but nowhere part of the group you can't just sit back...that is also a good thing of the TechnoLab because they give you opportunities to work in groups of three. I think the size of the group is very handable and even the way we are situated at the table there. I don't think anybody has a superiority over somebody else, there's nobody at the head of the table, we are all sitting at the side of the table."

The literature emphasises that teamwork based on sound competitive principles promotes perseverance. On the basis of the obligation towards the group, the best achievements are strove for in the interest of the group (Biehler & Snowman, 1993:525; Wakefield, 1996:531).

### The hands-on learning approach

Respondents experienced the hands-on learning approach in the TechnoLab as challenging, interesting, motivating, exciting, meaningful and enjoyable as illustrated by the following quotations:

"...working with lego blocks ... challenging and interesting problems.."

*"baie krities en kreatief"* (very critical and creative)

"It was interesting to work with the model

and try to apply them in life situations. It also make it easier to present a lesson of Technology Education very simple to your students so that they can understand you."

"...quite interesting and motivating because of the practical work that we did...The new knowledge and skill were correlating with the old existing knowledge which we have learned idea of how to apply the gears...The use of legos was fun and to play with it makes us to solve the problem we have identified, to analyse, make choice which are possible and to design and make the product and finally to evaluate the product against the identification and possible solution."

"It was most challenging, interesting and found that one was constantly fighting time. It was so enjoyable that I wanted to do more and hope to learn more about motorised models. This practical hand on experience was more stimulating, required deep thinking and is an experience that I would recall with much delight. Also it was meaningful in a sense that I could now bring together the theory as well as the practical and thus gain a better insight and understanding."

"Learning becomes so interesting and one is forced to think, plan, decide and make something in a simple way and practically relaxed situation."

"I have enjoyed to see how the theory of the process like decision making, problem solving, designing and technological process taking while I am part of the doing...The work done in technological process is actually first done in critical and creative process. Unless one thinks and thinks critically and creative the technological problems becomes difficult."

"It was a mind-on and hands-on experience."

"Once we got involved in the making of the gears it became very interesting and exciting. Making the model was stimulating as you had to think of different ways to connect the parts together, to make them move...It was very stimulating and exciting experience. I thoroughly enjoyed it. It was a morning full of fun."

"It's actually funny while we were having fun we were learning, we were using processes and challenging as well I never knew that playing with lego was so interesting (laugh)."

"It is also challenging in a sense that it tackles your mind even if you don't have the background information you tend to explore. You're playing with resources that you have in front of you and you go on."

"...we were confronted by a problem and suddenly we realise that we have a problem. What are we going to do about this problem. What is the problem and we dig back into our brains, we dig back into our experience, we dig back into values

and attitude. I mean if we have a negative attitude."

This finding is supported by the literature. It is generally accepted that the fascination and enjoyment experienced in the learning situation and in performing a task/project, elicit a specific motivation resulting in the required commitment and perseverance by the student to remain involved until final success is eventually achieved (Amabile, 1983:366; Langer & Brown, in Langer, 1993:49; Perkins, 1992:45; Petty, 1997:176). If the student enjoys the task and subsequently displays greater interest in it, it will create a heightened opportunity for learning (Reece & Walker, 1997:96/97). The fact that enthusiasm and excitement in a specific learning situation is contagious and will influence other students, is also supported by other researchers (Secules et al., 1997:59). It is important that students care about and feel positively about experiences in the classroom because it influences the student's enthusiasm for the task and eventually also the accompanying learning enhancement (Gunter et al., 1995:38).

## Fear and Anxiety were Experienced in the Unknown Situation, that is the Technolab and Technology Education

Two categories of experience in this theme were reflected in the data, namely fear and anxiety because of the unknown situation and the difficulty experienced in mastering a new situation. **Respondents voiced their initial experience of fear and anxiety because of not having any information regarding the TechnoLab and the assignments they had to complete.** The following quotations highlight this experience:

"I entered afraid and feeling anxious. I was fearful of being faced with something that I could not do."

"Not knowing what was to be done from the outset made it even more exiting. This, however, tended to involve nervousness which in first affected performance to a certain degree."

"I was a little worried and not as comfortable when I first came in."

"At first was a bit apprehensive at to what we were going to do. A bit hesitant as it was a new experience - did not know what to expect and what was expected of us."

"...we're not have been actually prepared about what was going to take place there, it made us somehow feel anxious you know and looking forward to see what was actually taking place in

that particular lab."

"...but now coming to the legos I also not knowing how to use it when I first came in there I was a little bit uncomfortable because I thought of this practical test." "I felt slightly threatened in the beginning because of my lack of technical knowledge with something like the gear."

**Respondents also expressed their experience of having difficulty in mastering the new experience of functioning in a TechnoLab.** Quotations that demonstrate this are the following:

"Using lego blocks we had to design a vehicle with an advertisement board that rotates coming up with possible solution was real difficult since I am not mechanically inclined..."

"When we worked with the lego, however we encountered problems as we did not know how the different parts fit together and their different functions... When we made the solution more problems were experienced as the solution didn't always worked. Mostly because the material caused problems and therefore problem solving (how fit it together) within the big problem and we had to continue to evaluate the design."

"I had difficulty in understanding the work on gears and a second problem was being familiar enough with the actual lego pieces - thereby not understanding to well what piece could work here, or the function of each piece."

"It was for the first time using my mind creatively and critical and I have realised that it is not easy to be critical and creative."

According to the literature students usually have the problem of overcoming initial anxiety related to a strange assignment (Wakefield, 1996:515) and this type of commitment requires energy to go into action. One can describe this kind of energy in terms of creativity and productivity as "positive stress", especially when tasks permit individuals to use their abilities, when they believe the pressures are legitimate, and when they share in the fruits of success (Couger, 1995:349). Positive stress can lead to intrinsic motivation to commence a task and to persevere with it. In each person there is a need for achievement, encouraged by successful experiences and a natural inclination to avoid failure (Biehler & Snowman, 1993:520). Courage is required to take risks and to persevere in completing a task (Petty, 1997:61).

The facilitator probably has a role to play by seeing to it that the energy is applied positively, because a student has a natural tendency for "... fear of making mistakes or taking risks ... we are afraid of looking silly or embarrassing ourselves..." (Evans, 1991:349). In the learning situation there is a danger of not

thinking and learning in an original and imaginative way and therefore missing out on the creative way: "Failure avoiding students ... avoid failure by sticking to what they know, by not taking risks, or by claiming not to care about their performances" (Woolfolk, 1995:355).

## Empowerment Through Exposure to the Technolab and Technology Education

Respondents experienced being empowered through exposure to the TechnoLab and Technology Education because they were required to reason outside their normal frame of reference. When they were successful in completing their assignments they experienced a sense of achievement. Quotations to illustrate the respondents being required **to reason out of their normal frame-work of reference** are the following:

*"Ek moes buite my normale verwysing dink en doen wat bewys dat mens oor meer potensiaal beskik as wat jy gebruik."* (I had to think and act outside my normal frame of reference and that proves that a person has more potential than you use).

"This is an eye opener that Technology Education is everywhere, but that we are not aware of it".

"...I learned a lot that I have to understand the nature of the problem to get it very clear and I have to think and think well which show the importance of critical and creative thinking in the technological process. It was really proved there that it is very important to do critical and creative thinking in order to solve problems effectively. It was all activities even their hands on are true but you work very hard in the mind doing those activities practically."

The literature supports this finding. Students were given an opportunity for self-discovery and original thinking during this workshop and were forced to take thinking risks. This kind of experience can be defined as empowerment, which covers the intrinsic feeling of being in command (Biehler & Snowman, 1993:350; Hunter, 1993:104; Couger 1995:368; Woolfolk, 1995:390; Petty, 1997:185). Because the respondents were required to apply higher order thinking skills (Paul, 1993:282), it obviously made demands on perseverance, creativity and self-confidence to proceed with the project. It was therefore important that they believed in themselves and their own abilities – and a "can do attitude" was needed (Hunter, 1993:104; Wakefield, 1996:514). By exposing students to situations where they were required to take academic risks, a positive

effect on self-confidence and motivation resulted. In the learning situation the student is generally concerned with the achievement of academic success (Biehler & Snowman, 1993:350; James, 1996:81; Sternberg, 1996:82) which sometimes demands academic risk taking (Clifford & Chou, 1991:506). If the learning task can contribute to increased self-confidence and motivation, work of higher quality is delivered and the self-esteem of the student is enhanced (Petty, 1997:182).

**The respondents experienced a sense of achievement when they were able to carry out the assignment in the TechnoLab.** The following quotations illustrate this:

"I feel quite happy being one of the course because I can now be able to face future with a smile."

"I have to say that, I felt so proud because two of our products really worked and that is a nice feeling."

"Eventually, the problem was solved and our car worked. The outcome was according to the original problem identified and stated."

"...so we discovered and we must be proud of that because we were new, self discovery was there and then another thing we were capable and again at least you know working with those things for the first time to discover everything and take this if we have time then it was fine..."

"...for the first time we were able to design something even if we couldn't finish it because we're new, but we didn't fold hands at least you know the process of technology which has taken different steps that we're brought up from theory like there was creative thinking and then there was decision making and then there was possible solutions..."

*"En dit laat 'n mens net besef jy kan baie meer dinge uitdink as wat jy gedink het jy kan. Ek sou nie voorheen gedink het ek kan dit doen nie..."* (And this makes me realise that you can think out more things than what you thought you could. I would not have previously thought that I could do it..."

According to the literature achievement is the expansion of ability, mental discipline and innovation which develops in the individual and is frequently defined in terms of the self-concept which is an individual's assessment of his or her own strengths and weaknesses (Wakefield, 1996:223). An "internal locus of evaluation" is one of the conditions for creative thinking development: "... this refers to personal characteristics of self-confidence and independence, a tendency to make one's own judgements, and a willingness to accept responsibility for one's success and failures" (Couger 1995:368; Wolk, 1994:45; Secules et

al., 1997:56).

## CONCLUSIONS AND RECOMMENDATIONS

This study has indicated that the exposure of post graduate education students to the TechnoLab at the Faculty of Engineering was successful and stimulating due to an environment conducive to learning. The tutor's approach, co-operation between the group members, the sense of security associated with group work, the sense of competition between the various groups and the hands-on learning approach contributed towards an environment conducive to learning. The students furthermore indicated that they were empowered because they had to think outside their normal frame of reference. They also experienced a sense of achievement based on their capability of generating solutions. The difficulty of mastering the new experience caused by the unfamiliarity with the medium within the TechnoLab could also have had a negative effect on learning. The unfamiliar environment could have hampered risk-taking, innovation and therefore creativity.

Based on the findings of this study, the following recommendations can be made. An existing facility like the TechnoLab established mainly to enhance technology awareness in school learners and teachers, can successfully be integrated in training post graduate education students in the learning area of Technology. There are, however, certain conditions:

- Firstly, the learning environment would be conducive to learning, i.e. the tutor should take the role of facilitator, ample opportunities for group work should be incorporated, healthy competition between groups should be encouraged and students should be exposed to hands-on experiences.
- Secondly, the nature of the assignments should be such that students are encouraged to think outside their normal frame of reference in order to empower them. However, the degree of difficulty of the assignments should fall within the capabilities of the students to enable them to complete their tasks. This would, in turn, lead to a sense of achievement.
- Thirdly, one should keep in mind that the unfamiliarity of the learning environment can lead to students' anxiety before entering into the learning situation. To prevent restricting innovation and creativity students ought to be provided with ample opportunity to become acquainted with the medium with which they work. This would lead to more ease

in mastering the new experience, which will contribute towards a sense of achievement.

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