References


International Entrepreneurship 2009 @ www.internationalentrepreneurship.com


Magee, C. (2003). Advancing Inventive Creativity through Education. The LEMELSON MIT.


Appendix A1

Interview Schedules (Undergraduates)

1. What is the meaning of creativity to you?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

2. Do you think creativity should be developed in your classrooms and why?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

3. How often do you engage in classroom activities that compel you to think creatively?

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Often</th>
</tr>
</thead>
</table>

If rarely or often, elaborate on the activities you engage in:
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

____________________________________________________________
4. Have you ever been trained on specific creative problem-solving techniques or models such as TRIZ?
   
   If yes, elaborate on kind and nature of problem and application of TRIZ:
   
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

5. How often do you debate, discuss and disagree on certain learning content? (Need for consensus on response)
   
   Never Rarely Often
   
   If rarely or often elaborate:
   
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

6. Do you think you are capable of contributing new, improved or alternative engineering processes or procedures? (need for consensus response)
   
   Yes No
If yes or no elaborate

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

7. Do you think you should learn to think creatively? (Need for consensus response)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

Elaborate:

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

8. Do you think your classroom activities are doing enough to encourage you to think creatively?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

Elaborate:

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
Interview Schedule

Lecturer

Purpose:

To elicit opinions of each lecturer on existing classroom activities, the reasons for such activities and appropriateness if creativity is introduced as part of the classroom activities.

Title of Study:

Fostering Creativity in engineering undergraduates

Research Area: Curriculum Studies

Purpose of Research:

PhD Study
Request

Kindly share your views on the following issues as honestly as possible and where you feel uncomfortable responding to a question kindly decline to respond and always ask for clarity of the question

Theme 1: Teaching background, pedagogic expertise and experience

1. Do you hold a formal qualification in either engineering education or curriculum?
..................................................................................................................................................................

2. Have you ever attended any course or learnshop on engineering education or curriculum? If yes, elaborate on dates, venue, quality and transferability to own context
..................................................................................................................................................................
..................................................................................................................................................................
..................................................................................................................................................................
..................................................................................................................................................................

3. Since the adoption of OBE in 2004, have you ever attended any learnshop or trained on OBE and its implications for how you are teaching and assessing?
..................................................................................................................................................................
..................................................................................................................................................................
..................................................................................................................................................................
..................................................................................................................................................................

4. Have you ever been trained on how to encourage discussion, debate and dissent in your teaching without losing focus of the outcomes of learning? If yes elaborate on application in your teaching
..................................................................................................................................................................
..................................................................................................................................................................
..................................................................................................................................................................
..................................................................................................................................................................
5. Have you ever been trained on how to use Case Studies and Projects in your teaching? If yes, comment on application in your teaching.

Theme 2: Teaching and Learning

6. What are your normal teaching ways in final year undergraduate study?

7. How do you approach teaching and assessment in your final year undergraduate classes? Is it also the same way you approach first and second undergraduate classes?
Theme 3: Epistemic, Normative and Procedural beliefs

8. What do you consider as the role of learners in your own teaching?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

9. What do you consider as your role in teaching?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

10. How do you think assessment should take place in the final year of engineering undergraduate studies?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
Theme 3: Creativity and existing classroom practices

11. What is the meaning of creativity to you?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

12. Do you think it should be stimulated in final year undergraduate classes?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

If yes, how should creativity be stimulated in final undergraduate classes?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

13. What are the factors or things that make it difficult for you to encourage creativity in final year undergraduate classes?
14. What do you think should be done to encourage creativity in final year undergraduate classes?

__________________________________________________________________________________

__________________________________________________________________________________

__________________________________________________________________________________

__________________________________________________________________________________

__________________________________________________________________________________

15. Would it be worth your while to expose yourself to some literature on creativity?
## Appendix A2

### The Observational Protocol

<table>
<thead>
<tr>
<th>Themes Covered and key aspects of each theme</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Distributed Tentativeness (trust)</td>
<td>Check dominance of discussion, leadership challenges, and learning receptivity irrespective of position or role</td>
</tr>
<tr>
<td>- Willingness to learn</td>
<td></td>
</tr>
<tr>
<td>- Readiness to verify facts and share them</td>
<td></td>
</tr>
<tr>
<td>- Dealing with disconfirmation data</td>
<td></td>
</tr>
<tr>
<td>- Coping with learning anxiety</td>
<td></td>
</tr>
<tr>
<td>2. Aligned Intent (shared mental models)</td>
<td>How team actors deal with group dynamics, harness them towards a specific goal, reduce competition and foster co-operation</td>
</tr>
<tr>
<td>- Shared and understood meaning (problem, solution)</td>
<td></td>
</tr>
<tr>
<td>- Shared goals (common understanding of what needs to be achieved)</td>
<td></td>
</tr>
<tr>
<td>3. Genuine Dialogic Reconstruction</td>
<td>Check how team actors deal with verbal strategies that seek to silence or reduce the value of others views or force others into a particular view, carefully watch for these conversation safety violations, intervene when dialogue is in danger of degenerating into unproductiveness by focus groups meetings</td>
</tr>
<tr>
<td>- Creation of safe conversations</td>
<td></td>
</tr>
<tr>
<td>- Participants have a sense of being valued and wanted (each view counts for something)</td>
<td></td>
</tr>
<tr>
<td>4. Sensitiveness</td>
<td>Check the general atmosphere of the discussion for development and growth of collective goal, responsibility and accountability</td>
</tr>
<tr>
<td>- Respect for the views and contribution of all team actors</td>
<td></td>
</tr>
<tr>
<td>- Discussion and debates based on integrity (meeting the demands of fairness)</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B

TTCT

Activities 1-3: Ask and Guess

The first three activities are based on a given picture and test the candidates’ abilities to ask relevant questions about things they see but do not understand and hazard guesses as to the possible causes and consequences of what is happening or might have happened in the picture.

Activity 4: Product Improvement

The candidates are shown a stuffed toy monkey – the kind you can buy in ordinary stores. The toy monkey is about six inches tall and weighs about 168g (six ounces). Candidates are expected to think about the cleverest, most interesting and unusual ways of changing the toy monkey so that children could have improved fun playing with it.

Activity 5: Unusual Uses (Tin Cans)

The candidates are expected to come up with interesting and unusual ways of using tin cans for something of value. The tin cans size is unimportant as long as it is a tin can.

Activity 7: Just Suppose

The candidates are given an improbable situation, in this case, it is suggested that a great fog fell over the earth and all that people could see of other people are their feet. The candidates are then requested to explain what would transpire and how that would change life on earth.

All these activities are timed and spaces are provided on the test sheet for candidates to complete on. Candidates are, however, encouraged to use extra paper as and when such a need arises. The scoring of the TTCT can be done by lecturers or educators as long as they stick to the Scoring and Interpreting Results manual.

A study conducted to find out how trained and untrained scorers would perform, that is, the reliability of their scoring shows that the mean reliability coefficients for the verbal tests are: Fluency, 0.99; flexibility, 0.95 and originality, 0.91. This means that a person who meticulously applies the manual instruction should not find it difficult to score the TTCT accurately.
Appendix C

Letter of Permission

Research Committee Chairperson

I am a PhD student in curriculum studies at the University of the Witwatersrand and request permission to conduct research on creativity within the final year engineering undergraduates. The main purpose of the study is to facilitate, through a Sequential, Transformative Mixed (Invitational Engagement) Research methods, the selection and implementation of a creativity conception that may foster engineering creativity in these classrooms. Invitational Engagement Research method is a combination of Action Research, Bakhtin’s Model of Engagement and the pre- and post measures of an experimental design (see appendix).

The study will cause minimal interruption in the scheduling of classroom activities as it involves what is taking place in the classroom during the normal course of learning with some changes on classroom activities that are directly related to the syllabus of the students.

I have already held discussions with three of your lecturers in the final year undergraduate classes and have shown keen interest in the study as it relates directly to OBE curriculum enactment challenges.

It is my wish to cooperate fully with whatever specifications attached to this request.

Warm regards,

Teboho Pitso
Appendix D

Letter of Consent

I (name in full).................................................................hereby agree to participate in the research that is conducted by Teboho Pitso for his PhD studies. I am fully aware that my contribution as a research participant in this study will form part of the main body of this PhD study and that the information elicited in this research will be used for educational purposes only.

I also participate voluntarily in this research and reserves the right to withdraw from it as and when I feel violated or when my human dignity is compromised in any way. I also understand that my name and that of the institution shall remain anonymous in the research and the thesis.
Appendix E

Creativity Model (Pilot Phase)

Resources\inputs

a) Natural resources  Nature of the problem
b) Time resources   -contradiction
c) Space resources   -diagnosis
d) System resources -trimming
e) Energy resources -analogy
f) Human resources  -synthesis

- genesis

Outcomes

1. Is the system working near-perfect?
2. What does it mean to say it works near-perfect?
Appendix F

CASE STUDIES

Greening your Institution

Three critical resources are necessary for the normal and optimal operation of your institution – water, energy and paper. It is estimated that on average one South African uses 156 litres of water per day and it takes an average of 11,000 litres of water to make one pair of jeans and almost 400,000 litres of water are used to produce one car. Given that South Africa is already importing water through the Midlands Projects from Lesotho and has erratic weather patterns, water has become a critical resource that needs careful use.

Based on the information above, calculate the average water usage in your institution per month and also suggest ways of reducing water wastage and promoting prudent use of water.

Secondly, try to find out how much energy is used in your institution per month and translate that to the amount of coal and water used to produce that energy per month and, suggest ways of raising awareness on prudent use of energy and alternative energy sources. NB. Check the viability of the alternative energy sources and the trade offs necessary for implementability in your institution.

Thirdly, try to find out how much paper is used in your institution per month and translate that to the number of trees that are chopped to produce that paper and, suggest ways of reducing paper wastage and alternatives to paper.
Appendix G

The Conference Presentations Abstracts

Co-author (Name Withheld)

Computer Systems and Process Instrumentation

Teboho Pitso
Learning Development
Vaal University of Technology
biki@vut.ac.za

Title:

Abstract
South Africa already imports water from places such as Lesotho which makes water a scarce resource in this country. One of the ways water is lost and needs to be improved is through timely detection of water leakages throughout the water distribution network. One of the major contributors in revenue water loss is the pipeline leakages. The South African water industry has invested in equipments that detect and localize leaks in the water distribution systems. However; in terms of the local municipalities' by-laws in South Africa, water leakages that occur within residential and private areas are the responsibility of the owner. Without an accurate means of detecting these leaks, the residential and private owners are at the mercy of business entities that charge exorbitant prices to detect and fix these pipeline leakages. This article explores water leak detection at a micro-level where cheaper, reliable and easy-to-use water leak detectors can be produced together with advanced pipeline sealing products.
The framework of such an invention is the acoustic method. The principle of acoustic is that whenever a leak is present in a water pipeline, noise is generated and will travel along the pipeline. Through the acoustic leak detection method, the distance traveled by the noise in the pipeline can be calculated and such sound wave data can be captured and calculated by an electronic device to pinpoint the exact location of the leak. Factors such as pipe size and length, materials and surrounding conditions are crucial variables in determining the accuracy and reliability of the acoustic-based devices. We share preliminary challenges on the accuracy of leak noise correlator in pinpointing leaks.
Title:

Unleashing Ideality Entrepreneurship in Engineering Undergraduate Curriculum: A Case for One University of Technology (UoT) in South Africa

Abstract

Based on the understanding that the absorption rate of new recruits by the economy has dwindled to under 4% (Davies, 2001) and the labour anomaly that shows that increasingly the UoTs engineering graduates are joining the unemployment queue despite the fact that the economy shows a need of such skills at its intermediate level which is a claimed niche of UoTs (Howitz, 2007; Pauw et al, 2006), I developed a Creativity Model that sought to unleash the ideality entrepreneurship of engineering undergraduates. Ideality Entrepreneurship refers to opportunity-seeking actions and efforts through continuous systematic investigation of the near-perfect status of an existing technology or system that could lead to improvement, retiring or re-inventing and possible venture creation (Pitso, 2009). Ideality entrepreneurship thus subsists on inventiveness which refers to creative problem-solving or creation to improve existing technology (Taylor, 1959). 24 Power Engineering undergraduates were exposed to the Creativity Model, for a semester, which they used to seek-out the higher designs of Eskom energy mix which is still 90% coal-based. The 24 undergraduates were pre-and post-tested on their creative thinking abilities through the standardized Torrance’s Tests of Creative Thinking (TTCT) which measures undergraduates’ fluency, flexibility and originality of generated ideas. The test results show that the fluency and flexibility ideas of the undergraduates increased substantially while the originality ideas improved modestly after exposure to the Creativity Model. The modest improvement on the originality ideas of undergraduates points to the entrenched curricular assumptions that have been shaping UoTs learning which inclines towards reproductive learning.