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Thesis

**Fostering Creativity in Engineering Undergraduates**

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# Fostering Creativity in Engineering Undergraduates

**Teboho Pitso**

A thesis submitted to the Wits School of Education in the Faculty of Humanities,  
University of the Witwatersrand in fulfillment of the requirements for the Degree of

**Doctor of Philosophy in Education**

**Johannesburg, February 2011**

## DECLARATION

I declare that this thesis is my own unaided work. It is being submitted for the degree of Doctor of Philosophy in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other university, nor has it been prepared under the tutelage or with assistance of any other body or organization or person outside the University of the Witwatersrand, Johannesburg.

Teboho Pitso

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15 February 2011.

## ABSTRACT

Since their establishment in the 1960s, Universities of Technology in South Africa have been taking pride in providing career-focused qualifications that match the intermediate needs of the economy. In order to provide these career-focused qualifications, these institutions have been focusing on enacting a curriculum framework that emphasizes replication of industrial processes which tended to accentuate routinized, conventional problem-solving. The shift in economic paradigm in the 21<sup>st</sup> Century and the general dissatisfaction with graduate readiness in the workplace as evident in both local and international literature, framed as employability skills or generic skills, suggest a new impetus being placed on creativity, especially in engineering education. This study attempted to develop final-year undergraduates' creativity through making visible the key features of a pedagogic practice, by analyzing the existing engineering undergraduate pedagogic practices, and reconceptualizing and testing a pedagogy that could potentially develop undergraduates' creativity. The reconceptualized pedagogy, enacted as "*learnshops*", accentuated teamwork, collaborative inquiry, guided creative problem-solving and the use of case studies to encourage students to seek the higher designs of water, paper and energy technologies within their institution. Design-Based Research (DBR) frames the methodology and methods of data collection and analysis.

The research results show that existing engineering undergraduate pedagogic practices remain trapped in the skills training discourse that emphasizes conventional problem-solving in curriculum enactment. Students' meanings of creativity remain generally eclectic prior and post involvement in the *learnshops*, although students' creativity conceptions become more focused on imagination and resourcefulness post-*learnshops*. The Torrance Tests of Creative Thinking (TTCT) scores show that students' creativity increased as a result of exposure to *learnshops*. Students working in teams of intermediate size to creatively solve given open-ended tasks related to sustainable development were able to achieve cooperation and generate useful ideas with the help of pedagogic interventions implemented during the *learnshops*. Itinerant membership as an aspect of team formation has little effect on teams' generation of ideas.

**Keywords:** Creativity, curriculum, pedagogy, *learnshops*, teamwork, DBR

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Once in a while, out of the blue, comes a person who touches your life in extraordinary ways and leaves an indelible mark in the sand of your time. That person is Professor Shirley Booth who not only guided me through the rough terrains of research but raised my international profile by means of inviting me to serve in the Scholarship of Teaching and Learning (SoTL) Project. With refreshing insight and critical astuteness, Professor Shirley Booth refined the focus of the study in ways that sophisticated the study's core argument. *Ke a leboha, mme Shirley ka ho phatlalatsa dikgeo tshimong ya ka!*

At times, in our long and arduous academic journeys, our ability to see far gets restricted by tunnel vision and needs another human being to rekindle our seeing anew. I have cause to express, with deep gratitude and appreciation, the significant role Professor Ruksana Osman played in refining my thesis. Ngiyabonga, ngiyangcongcoza nkosikazi Ruksana!

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## DEDICATION

This study is dedicated to the loving memory of my parents, Liphaphang and Disebo, my grandparents, George and Sesi Pitso; Molefi and Matshediso Ramatsebe, my brother George Makhunga and my mentors, Dr. Phakisa Mokhesi, Mokhethi Phatang and Motsitsi Khutsoane. It is further dedicated to the one who has been burning the midnight oil with me and steadying the home front ship, Matumelo, my siblings, Tumelo, Lefu, Lucky and Mamohlolo and Mankosi as well as my children, Molefi, Motsitsi, Tsebo and Sesi and their brother TsitsiTsitsi and his family. To my friend, Hlakanyane Moleli.

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*To the Makhunga clan*

*Umakhunga benkosi*

*Bezinzapho ezimnyama*

*ukuqhwayane!*

*Ndebele likaMthimkhulu, Bhungane*

*Umaukhula, uyephezulu*

*Uhlambe ilangalibalele*

*Emfuleni woTugela*

*Wenamfazi, umabele made*

*Umauminyisi umntwana*

*Uphosela amabele*

*Phezukomfula woTugela*

*Hlubi! Umangelengele!*

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Our meddling intellect

Mis-shapes the beautiful forms of things....William Wordsworth



PRAIRE, SASKATCHEWAN, 2008, BY SCOTT CONARROE

**End of the Line**

**By Sergi Pàmies**

**TRANSLATED FROM THE CATALAN BY LISA M. DILLMAN**

**Six days a week, at the exact same time**, the locomotive slices through the stillness of the landscape. Neither the trees nor the hills take note; only the cow watches the train go by. From his cab, the engineer waves a hand in greeting and the animal responds by swishing her tail back and forth, which also serves to fan her udders. They've been repeating this ritual for years, but the engineer knows that today is the last time. He's retiring tomorrow. He'll have time to tend the tiny patch of grass by the door of the house he's finally paid off. He'll be able to take vacations during low season, at discounted prices. He'll no longer have to try to motivate himself every morning by repeating that work is a source of dignity, or to endure the presence of his assistant, a sullen, stingy man. The engineer pulls out of the station, his head filled with endless plans – most of which are actually feasible. He pays no attention to the winding tunnels leading to a series of rundown suburbs or the buildings lining the tracks, crowned with neon-lit advertising. He isn't taking pleasure in his final moments, or thinking that he'll never again be in charge of the locomotive's throttle. His mind wandering through a nap-filled future, he drives past the urban sprawl and towards a landscape where various shades of green and the intermittent smell of manure prevail. When he sees the cow in the distance, he instinctively reduces his speed, noting his assistant's look of disapproval. As he nears the cow it occurs to him that simply waving is not enough. So he slows down, his eye on the speedometer's needle until it comes to rest at zero. Slowly – trying not to jam his spine and set off his chronic back pain – he climbs down onto the tracks. With the faltering steps of a man unaccustomed to seeing his feet when he walks, he crosses the field toward the cow. The animal, having sensed the train halting, stops swishing her tail. She turns her head to get a better look at the engineer, who gingerly – as if rather than a cow she were a lion – reaches out a hand to pet the animal. The ruminant lets out a moo that scares off the swarm of flies normally clustered around her eyes. She glances at the train. Despite the distance she can make out the thin spiral of smoke trailing up from the sullen assistant's cigarette. At the windows, passengers shout, demanding that the engineer get back immediately. They have no time to waste, they say. This is unacceptable. A more patient minority, however, looks on as a man who – judging by his uniform – must be an engineer hugs a cow for what seems quite some time and then, having finished, returns to the train with the satisfaction of one who has done his duty.

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