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IMPLEMENTING A PROBLEM-BASED LEARNING MODEL IN THE TRAINING OF TEACHERS FOR AN OUTCOMES-BASED TECHNOLOGY CURRICULUM

by

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Our underlying frames, gestalts, paradigms, big pictures are everywhere in doubt. The task is to understand how we acquire frames, how we communicate them, and how we change them in ourselves and others - Peter Vail.

The significant problems we face cannot be solved at the same level of thinking we were at when we created them - Albert Einstein.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABET	Adult Basic Education and Training
ANC	African National Congress
C2005	Curriculum 2005
CEPD	Centre for Education Policy Development
CERI	Centre for Educational Research and Innovation
CFC	Consultative Forum on Curriculum
CUMSA	Curriculum Committee for South Africa
ECD	Early Childhood Development
ETDP	Education, Training and Development Practitioners
ETQAs	Education and Training Quality Assurers
FET	Further Education and Training
FETC	Further Education and Training Certificate
FRD	Foundation for Research Development (South African)
GET	General Education and Training
GETC	General Education and Training Certificate
HEDCOM	Heads id Education Department Committee
HETC	Higher Education and Training Council
HSRC	Human Sciences Research Council
IEA	International Association for the Evaluation of Educational Achievement
IEB	Independent Examinations Board
INSET	In-service Education and Training
LSEN	Learners with Special Education Needs
NEPI	National Education Policy Investigation
NGOs	Non-governmental Organisations
NICD	National Institute for Curriculum Development
NILLD	National Institute for Lifelong Learning Development
NQF	National Qualifications Framework
NSBs	National Standards Bodies
NSF	National Science Foundation (American)
NTB	National Training Board
NTT	National Task Team

OBE	Outcomes-Based Education
OECD	Organisation for Economic Co-operation and Development
PBL	Problem-based Learning
PRESET	Pre-service Education and Training
PTT	Provincial Task Team
RDP	Reconstruction and Development Programme
RPL	Recognition of Prior Learning
SACATE	South African Council for the Accreditation of Teacher Education
SAQA	South African Qualifications Authority
SGBs	Standards Generating Bodies
STS	Science Technology Society
TIMSS	Third International Mathematics and Science Survey

GLOSSARY OF WORKING TERMS

In this thesis, the following meanings are assigned to key terms, consistent with their current use in South Africa.

Accreditation — A procedure by which an authoritative body gives formal recognition that an institute, body or person is competent in terms of a specific purpose.

Applied competence — Is the combination of a learner's demonstrated ability, in an authentic context, to consider a range of possibilities for action (practical), and based on an understanding of the underpinning knowledge and thinking (foundational), to adapt to changing unforeseen circumstances (reflexive).

Assessment — The process of collecting and interpreting evidence of learner achievement.

Assessment criteria — The criteria included in a unit standard to determine the achievement of specific and critical outcomes.

Competence — The capacity for continuing performance within specified ranges and contexts, resulting from the integration of a number of specific outcomes.

Core learning — The specific core knowledge, skills and attitudes required for the completion of a particular qualification i.e. the required specialism for the purpose of the qualification.

Credit — The recognition by an accredited body that a learner has satisfied the outcomes of a unit of learning expressed as a credit value at a specific level. Credits may be accumulated until conditions for a qualification have been met.

Curriculum framework — The philosophical and organisational framework for a specific curriculum.

Curriculum 2005 — The renewed curriculum framework for compulsory school years (Grade 1 through 9) and which was said to be based on transformation OBE principles. Curriculum 2005 specifies the 66 specific outcomes for the eight Learning Areas, together with the assessment criteria and range statement for each specific outcome. The 2005 is a time frame label indicating that the new curriculum framework had to be phased in all

grades up to grade 12 by the year 2005.

Elective learning	Optional credits within a formal learning programme that may be of personal interest or professional relevance, or that open the door to a range of possible career and vocational choices.
Evaluation	The process whereby the information obtained through assessment is interpreted to make judgements about a learner's competence.
Integration of education and training	The human resource development policy rejects the rigid division between "academic" and "applied", between "theory" and "practice" and between "knowledge" and "skills" in order to avoid the past perception that education possessed higher academic status than training. Both have equal status and importance.
Learning Area	It represents a broader knowledge field which is informed by the commonalities it shares with other areas of learning which ensure that fragmented views of learning are counteracted. Learning programmes will be developed which integrate learning experiences from various Learning Areas.
Lifelong learning	Ongoing learning through a continuous supportive process that stimulates and empowers individuals to acquire and apply knowledge, values, skills and critical understanding, required to respond confidently and creatively and to rise to the challenges of a changing social, political and economical environment.
Outcomes-based education	A learner-centred, result-orientated approach based on the belief that all learners can learn and succeed. It implies that learning institutions control the conditions for success. Curriculum design starts from a clear definition of the significant learning that learners have to achieve – all decisions about instructional strategies, learner assessment and organisation of the learning environment are linked directly to the outcomes that learners have to demonstrate.
Problem-based learning	Is the learning that results from the process of working. toward understanding or resolution of a problem. The problem

is encountered first in the learning process and serves as a focus or stimulus for the application of problem-solving or reasoning skills, as well as for the search for information or knowledge needed to understand the mechanisms responsible for the problem and how it might be resolved. It also implies a curriculum design approach where the outcomes are organised around problems. PBL also implies a particular strategy for facilitating learning.

Programmes A planned combination of learning outcomes, which results in credit accumulation towards the achievement of a qualification.

Technology education Concerns the technological knowledge and skills, as well as the technological processes, and involves understanding the impact of technology on both the individual and society. It is ultimately designed to promote the capability of and to stimulate learners to contribute towards problem-solving.

SUMMARY

Since the democratic elections in South Africa in 1994, the socio-political transformation impacted on the paradigms that are evolving in education and training in two important ways – it introduced a new philosophical base for education and training, and it established new systemic structures for organising and managing education and training. These reforms were based on a vision of lifelong learning for all South Africans and both the philosophical base and structures for its implementation were based broadly on the concept of transformational outcomes-based education. Introduction of this new paradigm set in motion a process of curriculum reform across all fields of education and training. For the years of compulsory schooling, the new curriculum framework was known as Curriculum 2005. This structure divided the school curriculum into eight Learning Areas, one of which was called Technology and that was never previously presented in public South African schools.

The realities of a new paradigm and a new Learning Area compelled teacher educators to design new programmes and methodologies to prepare prospective and in-service teachers for the daunting task of teaching. This research focused on preparing pre-service final year high school teachers in the natural sciences to facilitate learning in technology from an outcomes-based perspective. This research explored problem-based learning (PBL) as a curriculum design type where the entire curriculum of a particular course is organised around problems and as a strategy to be used for training the pre-service teachers. The rationale for using PBL is the following:

- It is a strategy which has the potential to operationalise OBE principles in learning environments.
- It is a strategy which enhances the transferability of competence from university classroom to the real workplace, because of its embedded characteristic of authenticity.
- The syntactical nature and structure of PBL and technology education show strong similarities.

The outcome of the literature review was the development of a model called the OBE-PBL model. This model was implemented on two levels. First, it was used during the six month training of the pre-service teachers and second, the pre-service teachers had to

implement this model when they had to facilitate learning in technology education in real schools for one month. Quantitative data were gathered to determine how successful the pre-service teachers were in transferring their competencies gained through the OBE-PBL model in the authentic situation. The pre-service teachers taught the control groups in the schools according to the traditional instructional paradigm, while the experimental groups were taught according to the OBE-PBL model. Pre- and post-test, as well as experimental and control group comparisons were conducted to determine whether statistically significant differences were present and what the nature of these differences were. Data of a qualitative nature were gathered from learners, as well as through interviews with the pre-service teachers about their OBE-PBL training and classroom experience of implementing it.

The results showed that the pre-service teachers transferred their OBE-PBL competencies to such an extent that the post-test results of the experimental group were significantly better than their pre-test results. The post-test results of the experimental group were not significantly better than the post-test results of the contol group. However, the experimental group learners performed significantly better in higher cognitive questions that demanded meta-cognitive skills. Pre-service teachers indicated that the complete OBE-PBL experience was challenging but valuable, and one said that she has learnt the most in this course than she had learnt the whole year. The practice experience highlighted that some had a narrow view of their role as an OBE facilitator of learning in a PBL environment. After an in-depth reflection on all the dimensions of the findings, particular recommendations are made on how to develop and refine the OBE-PBL model further to enhance its suitability and impact on the training of pre-service teachers for technology education.

OPSOMMING

Sedert die demokratiese verkiesing in Suid-Afrika in 1994 het die sosio-politiese transformasie 'n direkte impak gehad op die paradigmas wat tans besig is om te ontvou in onderwys en opleiding op twee vername wyses – 'n nuwe filosofiese grondslag is bekengestel, asook 'n nuwe sistemiese struktuur wat verantwoordelik is vir die organisasie en bestuur van onderwys en opleiding. Die hervormingsinisiatiewe word aangedryf deur 'n visie van lewenslange leer vir alle Suid-Afrikaners en is gebaseer op die beginsels van

transformatiewe uitkomsgebasserde onderwys (UGO). Vir die verpligte skoolfase het die vernuwingsinisiatiewe gekulmineer in a kurrikulumraamwerk genaamd Kurrikulum 2005. Volgens hierdie raamwerk word die kurrikulum in agt Leerareas verdeel, waarvan Tegnologie een is wat nog nie vantevore amptelik in publieke skole aangebied is nie.

Die realiteite van 'n nuwe paradigma en Leerarea het onderwyseropleiers genoop om voor- en indiensprogramme te herkonseptualiseer en nuwe metodologieë te eksploreer om onderwysers toe te rus vir hul groot opgaaf. Hierdie navorsing het daarop gefokus om voornemende hoërskool onderwysstudente voor te berei om leer te fasiliteer in tegnologie-onderwys vanuit 'n uitkomsgebaseerde perspektief. Probleemgebaseerde leer (PBL) is geëksploreer as 'n kurrikulumontwerpbenadering waar probleemscenario's gebruik word om die kurrikulum te organiseer, asook 'n opleidingstrategie vir die onderwysstudente. Die rasionaal vir die implementering van PBL is die volgende:

- Die strategie het die potensiaal om UGO-praktykbeginsels te oprasionaliseer.
- As gevolg van die outentieke karakter van PBL kan bevoegdhede wat tydens opleiding ontwikkel word effektiewer oorgedra word na die werksplek.
- Die sintaktiese struktuur van PBL en tegnologie-onderwys toon sterk ooreenkomste.

Die uitkoms van die literatuuroorsig was die konstruksie van 'n model genaamd die UGO-PBL model. Hierdie model is op twee vlakke geïmplementeer. Eerstens is dit gebruik vir die ses maande opleiding van die onderwysstudente en tweedens moes hulle die model implementeer tydens die fasilitering van leer in tegnologie vir een maand in skole. Kwantitatiewe data is ingesamel om vas te stel hoe effektief die onderwysstudente hul bevoegdhede kon oordra na die praktysituasie. Die kontrolegroepe is onderrig volgens 'n tradisionale instruksie-transmissiemodel, terwyl die intervensies met die eksperimentele groepe op die UGO-PBL model gebaseer was. Kwalitatiewe data is vanaf leerders verkry, asook vanaf ondehoude wat met die onderwysstudente gevoer is oor hul UGO-PBL opleiding en praktykervaringe.

Die resultate het getoon dat die onderwysstudente hul UGO-PBL bevoegdhede sodanig oorgedra het dat die natoets van die eksperimentele groep beduidend beter was as hul voortoets. Die natoets van die eksperimentele groep was egter nie beduidend beter as die natoets van die kontrolegroep nie. Alhoewel, in sekere vrae wat as hoë kognitiewe vrae geklassifiseer was en wat meta-kognitiewe vaardighede vereis het vir beantwoording

daarvan, het die eksperimentele groep beduidend beter presteer. Die onderwysstudente het aangedui dat die omvattende UGO-PBL ervaring uitdagend en waardevol was en een het gemeld dat sy meer in hierdie kursus geleer het as in enige ander kursus gedurende die jaar. Data wat verkry is vanaf die praktykimplementering het egter getoon dat sommige onderwysstudente 'n verskraalde persepsie gehuldig het oor hul rol as UGO leerfasiliteerders in 'n probleemgebaseerde leeromgewing. Na afloop van deeglike refleksie op die veelvuldige dimensies van die bevindinge, word aanbevelings gemaak oor hoe om die model the verfyn sodat die geskiktheid en impak daarvan op die opleiding van tegnologie onderwysstudente kan verhoog.