



**A learning facilitation strategy for mathematics
in a support course for first year engineering students
at the University of Pretoria**

by

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*Love the Lord your God with all your heart and with all your soul and with all your mind and with all your strength. ...
Love your neighbour as yourself. There is no commandment greater than these.*

Mark 12:30-31



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List of Abbreviations

4YSP	Four Year Study Programme
5YSP	Five Year Study Programme
HBD	Herrmann Brain Dominance
HBDI	Herrmann Brain Dominance Instrument
ILS	Felder Solomon Index of Learning Styles
IP	Information processing
JPO110	First semester module code of the Professional Orientation Support Course
LAS	Lumsdaine and Lumsdaine Learning Activity Survey
MC	Mathematics confidence
POSC	Professional Orientation Support Course
PSB	Problem solving behaviour
SA	Study attitude
SE	Study environment
SH	Study habits
SOM	Study Orientation Questionnaire in Mathematics
SOMT	Study Orientation Questionnaire in Mathematics Tertiary
UP	University of Pretoria
WTW114	Module code of the standard first semester calculus module in 2000 and 2001
WTW158	Module code of the standard first semester calculus module in 2002



Glossary of Terms

2000 POSC group	Students enrolled for the Professional Orientation Support Course during 2000
2001 POSC group	Students enrolled for the Professional Orientation Support Course during 2001
2002 POSC group	Students enrolled for the Professional Orientation Support Course during 2002
Five Year Study Programme	Extended study programme in engineering at the University of Pretoria.
Four Year Study Programme	Regular study programme in engineering at the University of Pretoria.
learning style	Refers to an individual's preferred way of learning that has developed from genetics (nature) and fostered through education (nurture). It is also closely related to an individual's thinking style.
mainstream module/course	Refers to a module/course presented to all students enrolled for the specific module/course; is used alternately with the term standard module/course.
M-score	Used at the University to Pretoria for admission requirements and is based on performance in the final school examination.
potential	Potential regarding a specific aspect is genetically given; is dependant on biological development as well as education; development of potential leads to competency in the specific aspect.
Professional Orientation Support Course	Course presented as part of the curriculum in the Five Year Study Programme, School of Engineering, University of Pretoria.
SOM	Study Orientation Questionnaire in Mathematics developed by Maree (1996) and statistically processed by Maree, Claassen and Prinsloo (1997). The SOM was used as a pre-intervention instrument during the 2000 and 2001 research.



SOMT	<p>Study Orientation Questionnaire in Mathematics Tertiary.</p> <p>This term is used as a general term when referring to the study orientation questionnaire in a tertiary setting.</p> <p>This term is also used for the final version of the questionnaire presented in this thesis.</p>
SOMT-1	<p>Study Orientation Questionnaire in Mathematics Tertiary Version 1 which is the first edited version of the original SOM to portray a tertiary focus. Used in the 2001 research reported in this thesis.</p>
SOMT-2	<p>Study Orientation Questionnaire in Mathematics Tertiary Version 2 which is an edited version of the SOMT-1.</p> <p>Used in the 2002 research reported in this thesis</p>
SOMT-3	<p>Study Orientation Questionnaire in Mathematics Tertiary Version 3 which is an edited version of the SOMT-2 and represents the final edit as per this study.</p> <p>Used in the 2002 research reported in this thesis</p>
standard module/course	<p>Refers to a module/course presented to all students enrolled for the specific module/course; is used alternately with the term mainstream module/course</p>
study orientation	<p>Includes approaches to learning, motives for learning, styles of learning, elements of study methods and attitudes.</p>
thinking style	<p>Refers to an individual's preferred way of thinking that has developed from genetics (nature) and fostered through education (nurture). It is also closely related to an individual's learning style.</p>
whole brain learning whole brain learning facilitation	<p>Refers to the inclusion of different modes of learning (implying different thinking and learning preferences). On a physiological level different modes of learning are associated with cognitive activities in different parts of the brain.</p>



Key terms

Sleutel terme

Action research

Aksienavorsing

Composite approach

Saamgestelde benadering

Graphical exploration in mathematics

Grafiese eksplorاسie in wiskunde

Learning styles for mathematics

Leerstyle vir wiskunde

Learning facilitation strategy for mathematics

Leerfasiliteringstrategie vir wiskunde

Multifaceted approach

Veelfasettige benadering

Study orientation in mathematics

Studie-oriëntering in wiskunde

Tertiary mathematics education

Tersiêre wiskunde-onderrig

Thinking styles for mathematics

Denkstyle vir wiskunde

Whole brain learning

Heelbreinleer

Summary

A learning facilitation strategy for mathematics in a support course for first year engineering students at the University of Pretoria

by

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This thesis presents a conceptual framework for a learning facilitation strategy which is aimed at developing the mathematics potential of learners on an academic support programme. The study involved first year engineering students on an extended Five Year Study Programme in the School of Engineering at the University of Pretoria who were enrolled for the Professional Orientation Support Course during 2000-2002.

The learning facilitation strategy proposed and defined in this thesis originated in research conducted from 1993 to 1999 in the Faculty of Natural Sciences at the University of Pretoria. Insights gained through this research indicated that a combination of graphical exploration and analysis of graphical images could enhance students' understanding of fundamental mathematical concepts encountered in a first course in calculus. In the current study factors that appeared to contribute to this enhanced understanding were researched.

The strategy for learning facilitation of mathematics encompasses a multifaceted and composite approach. This includes a whole brain approach towards structuring the learning facilitation activities to accommodate and develop different modes of thinking and learning; to create in learners an awareness of the existence of thinking style and learning style preferences as well as an awareness of study orientation in mathematics, and to give learners insight into their own thinking and learning preferences and study orientation. Development of mathematics potential of learners is an important focus of this approach. Therefore, in addition to the above mentioned activities the mathematics potential of learners is also developed by facilitating their acquisition of appropriate learning and thinking skills and by structuring the learning environment to promote effective learning.

The proposed learning facilitation strategy for mathematics was implemented, monitored and assessed by way of action research studies during 2000-2002.

Results of the study indicate that the learners' thinking style and learning style preferences are diverse and represent a range of different preferences. Results also indicate that learners have a latent favourable study orientation towards mathematics. The effects of the proposed strategy's implementation on the learners' study orientation towards mathematics and on their performance in mathematics were investigated. The results indicate a significant improvement in the learners' study orientation towards mathematics. Their performance in the mainstream first semester calculus course confirmed their enhanced ability in mathematics. These results point towards efficacy that can be attributed to the implementation of the proposed learning facilitation strategy.

Results of this study also indicate that active involvement by both learners and facilitator in a multifaceted and composite approach to learning facilitation provides a suitable principle basis for structuring an academic support course. It provides for the development of learners and for the refining of course content to address the needs of the learners. It is envisaged that freshman students, other than those on an academic support programme, may benefit from a learning facilitation strategy for mathematics structured according to this multifaceted and composite approach.

Opsomming

'n Fasiliteringstrategie vir die leer van wiskunde in 'n ondersteuningskursus vir eerstejaarstudente in ingenieurswese aan die Universiteit van Pretoria

deur

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In hierdie proefskrif word 'n konseptuele raamwerk vir 'n leerfasiliteringstrategie voorgestel wat gerig is daarop om die wiskundepotensiaal van leerders in 'n akademiese ondersteuningsprogram te ontwikkel. Eerstejaar ingenieurstudente op die Vyfjaar Studieprogram in die Skool vir Ingenieurswese aan die Universiteit van Pretoria wat gedurende 2000-2002 vir die Professionele Oriënteringkursus ingeskryf was, het deelgeneem aan die navorsingaktiwiteite wat gerapporteer word.

Die leerfasiliteringstrategie wat in hierdie proefskrif voorgestel en gedefinieer word, het sy oorsprong gehad in navorsing vanaf 1993 tot 1999 in die Fakulteit Natuurwetenskappe aan die Universiteit van Pretoria. Insigte verkry deur hierdie navorsing het daarop gelei dat 'n kombinasie van grafiese eksplorasië en die analisering van grafiese beelde leerders se begrip bevorder van fundamentele wiskundebegrippe wat nodig is in 'n eerste kursus in calculus. In die studie van hierdie proefskrif word faktore ondersoek wat waarskynlik tot hierdie verbeterde begrip kan bydra.



Die strategie vir leerfasilitering van wiskunde behels 'n veelfasettige en saamgestelde benadering. Dit sluit in 'n heelbrein benadering tot die strukturering van leerfasiliteringaktiwiteite om verskillende denk- en leerstyle te akkommodeer en te ontwikkel; om leerders bewus te maak van hulle eie denk- en leerstylvoorkeure en om hulle bewus te maak van hulle studie-oriëntering in wiskunde, en ook om leerders insig te gee in hulle eie voorkeure en studie-oriëntering. Die ontwikkeling van die wiskundepotensiaal van leerders is 'n belangrike fokus in hierdie benadering. Bykomend tot die genoemde aktiwiteite, word die wiskundepotensiaal van leerders ook ontwikkel deur fasilitering van hulle verwerwing van toepaslike leer- en denkvaardighede en deurdat die leeromgewing gestruktureer word om effektiewe leer te bevorder.

Die voorgestelde leerfasiliteringstrategie vir wiskunde is by wyse van aksienavorsing gedurende 2000-2002 geïmplementeer, gemonitor en geassesseer.

Resultate van die studie dui aan dat die leerders se denk- en leerstylvoorkeure uiteenlopend is en 'n verskeidenheid van verskillende voorkeure insluit. Resultate dui ook daarop dat leerders 'n latente gunstige studie-oriëntering teenoor wiskunde het. Die moontlike effek van die voorgestelde leerfasiliteringstrategie op leerders se studie-oriëntering in wiskunde en op hulle prestasie in wiskunde is ook bepaal. Die resultate dui op 'n betekenisvolle verbetering in die leerders se studieoriëntering in wiskunde. Hulle prestasie in die hoofstroom eerstesemester kursus in calculus het hulle verbeterde vermoë in wiskunde bevestig. Hierdie resultate dui op gunstige uitkomst wat toegeskryf kan word aan die implementering van die voorgestelde leerfasiliteringstrategie.

Resultate van die studie dui ook daarop dat die aktiewe betrokkenheid van beide leerders en fasiliteerder in 'n veelfasettige en saamgestelde benadering tot leerfasilitering, 'n sinvolle beginselbasis bied vir die strukturering van 'n akademiese ondersteuningskursus. Dit bevorder die ontwikkeling van leerders en rig verfyning van kursusinhoud om in die behoeftes van die leerders te voorsien. Dit word voorsien dat nuweling eerstejaarstudente, benewens dié in 'n akademiese ondersteuningsprogram, sal kan baat by 'n leerfasiliteringstrategie vir wiskunde volgens hierdie veelfasettige en saamgestelde benadering.