UNIVERSITI PUTRA MALAYSIA

PREDICTIVE MODELS OF STUDENTS' MATHEMATICAL BELIEFS, SELF-REGULATED LEARNING AND THINKING SKILLS ON MATHEMATICS ABILITY OF UNIVERSITY STUDENTS

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DOCTOR OF PHILOSOPHY
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By

VELO SUTHAR

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy
December 2010

DEDICATION

...To my parents, teachers and friends, for their unending love and support.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment the requirement for the degree of Doctor of Philosophy

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Chairperson: Associate Prof. Rohani Ahmad Tarmizi, PhD

Faculty/Institute: Institute for Mathematical Research

In spite of a general agreement on the imperative impact of students' mathematics beliefs, self-regulated learning, thinking skills on mathematics ability of students among mathematics education researchers, still there is a lack of clarity from the conceptual viewpoint. A cultivating body of research consistently pointed out that mathematics beliefs, self-regulation and thinking skills play a vital role in facilitating and regulating students learning of mathematics and hence ability in mathematics. Previous research also indicated that self-regulated learning has extensive effects on students' thinking and specifically on mathematical thinking.

This study examined both the cognitive and affective factors contributing to mathematics ability in Malaysian higher education situation. This study was conducted to investigate the impact of students' mathematics beliefs, self-regulated learning and

thinking skills on mathematics ability of Malaysian undergraduate mathematics students using two predictive models namely, multiple linear regression model (MLR) and binary logistics regression (BLR). A self-reported questionnaire was used to assess students' mathematics beliefs, self-regulated learning and thinking skills.

Findings indicated that the significantly correlations between mathematics ability and sub-constructs of students' mathematics beliefs construct: "beliefs about one's ability in mathematics" ($r = .47$, $p < .001$), "students' beliefs about mathematics" ($r = .31$, $p < .001$), "beliefs about importance of mathematics" ($r = .25$, $p < .001$) and mathematics ability was also significant and positively related with overall students' mathematics beliefs ($r =. 38$, $p < .001$). The students' mathematics ability was significantly correlated with sub-constructs of self-regulated learning construct were time and study environment ($r = .42$, $p < .0.001$), organization ($r = .39$, $p < .0.001$), elaboration ($r = .372$, $p < .0.001$), rehearsal ($r = .33$, $p < .0.001$), meta-cognitive self-regulation ($r = .31$, $p < 0.001$ and mathematics ability was highly correlated with overall self-regulated learning construct ($r = .53$ $p < .0.001$). Similarly, the positive and strong correlations were obtained between mathematics ability and sub constructs of thinking skills construct: critical thinking skills, ($r = .76$, $p < .001$), problem solving skills, ($r = .403$, $p < .0.001$) and overall thinking skills construct, ($r = .676$, $p < .0.001$). This indicated that both critical thinking and problem solving skills are good predictors to enhance the students' mathematics ability.

Both the MLR and BLR were performed to assess the impact of students' mathematical beliefs, self-regulated learning and thinking skills on the likelihood that respondents

have high or low mathematics ability. An ANOVA test of the strength of significance of the multiple linear regression model was found to be highly significant [$F_{(1, 456)} = 73.912$, $p < .001$], protecting against the likelihood of Type-I errors, with a moderate effect size above the 90 percentile standing ($R^2 = 0.722$). Using the logistic regression analysis, eight predictors among the complete model containing all 13 predictors were statistically significant, χ^2 (15, N= 473) = 287.55, $p < 0.001$ indicating that the model was able to distinguish between respondents of high or low mathematical ability. The model as a whole explained **45.6**% (*Cox & Snell* R^2) and **64.5**% (*Nagelkerke* $\widetilde{R}^2$) of the variance in undergraduate students' mathematical ability. This model also correctly classified **85.4**% of the cases.

Overall analysis indicated that the twelve and nine independent variables ~~of~~ made a unique statistically significant contribution using the MLR and BLR models respectively. The strongest predictor of mathematics ability was beliefs about ones' ability in mathematics, recording an odds ratio of 2.58. Based on these findings, the study recommended that a longitudinal future research should be initiated to examine the influence of beliefs about ones' ability in mathematics on the students' mathematics ability. In addition, self-regulated learning, and thinking skills can also be attributed to the complex and dynamic interaction between cognitive and affective variables on mathematics ability.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

MODEL JANGKAAN TERHADAP PANDANGAN MATEMATIK, PEMBELAJARAN ATURAN KENDIRI DAN KEMAHIRAN BERFIKIR TERHADAP PENCAPAIAN MATEMATIK PELAJAR-PELAJAR SARJANA MUDA

Oleh

VELO SUTHAR

December 2010

Pengerusi : Profesor Madya Rohani Ahmad Tarmizi, PhD

Fakulti : Institut Penyelidikan Matematik (INSPEM)

Umumnya penyelidikan pendidikan matematik yang lepas mendapati bahawa persepsi pelajar terhadap matematik, pembelajaran aturan kendiri dan kemahiran berfikir pelajar memberikan kesan terhadap keupayaan dalam bermatematik. Namun dapatan ini tidak mampu memberikan penjelasan dari aspek konseptual pembelajaran. Kajian terbaru mendapati persepsi pelajar terhadap matematik, pembelajaran aturan kendiri dan kemahiran berfikir sangat membantu dalam pencapaian matematik khasnya untuk membentuk kemahiran berfikir secara matematik.

Kajian ini telah menyelidiki faktor kognitif dan afektif yang mana memberikan sumbangan terhadap kemampuan matematik pelajar institusi pengajian tinggi di Malaysia. Tujuan kajian ini untuk mengenalpasti kesan persepsi pelajar terhadap matematik, pembelajaran aturan kendiri dan kemahiran berfikir terhadap kemampuan matematik di kalangan pelajar sarjana muda Malaysia dengan menggunakan dua model iaitu Model Regresi Linear Berganda (MLR) dan Model Regresi Lojistik Binari (BLR) .

Pengukuran persepsi pelajar terhadap matematik, pembelajaran aturan kendiri dan kemahiran berfikir dilakukan dengan menggunakan borang soal selidik khas yang diisi sendiri oleh pelajar.

Hasil kajian menunjukkan terdapat signifikan kolerasi diantara kemampuan matematik dengan subkonstruk persepsi pelajar terdapat matematik konstruk: "persepsi individu tentang kemampuan matematik" ($r = .47$, $p < .001$), "persepsi pelajar tentang matematik" ($r = .31$, $p < .001$), "persepsi tentang kepentingan matematik" ($r = .25$, $p < .001$). Kemampuan matematik didapati signifikan dan berkait secara positif dengan persepsi pelajar terhadap matematik secara keseluruhannya ($r = .38$, $p < .001$). Kemampuan matematik pelajar juga signifikan kolerasi dengan sub-konstruk pembelajaran aturan kendiri iaitu masa dan persekitaran pembelajaran ($r = .42$, $p < .0.001$), organisasi ($r = .39$, $p < .0.001$), elaborasi ($r = .372$, $p < .0.001$), latihan ($r = .33$, $p < .0.001$) dan metakognitif kendiri ($r = .31$, $p < .0.001$). Kemampuan matematik juga didapati mempunyai kolerasi yang sangat tinggi dengan keseluruhan konstruk pembelajaran aturan kendiri ($r = .53$, $p < .0.001$). Hubungan kemampuan matematik dengan sub-konstruk kemahiran berfikir juga didapati mempunyai kolerasi yang kuat dan positif : kemahiran berfikir secara kritikal ($r = .76$, $p < .001$), kemahiran penyelesaian masalah ($r = .403$, $p < .001$) dan konstuk kemahiran berfikir secara keseluruhan ($r = .676$, $p < .001$). Hasil kajian ini menunjukkan bahawa kemahiran berfikir secara kritikal dan penyelesaian masalah adalah jangkaan yang baik untuk penambahbaikan kemampuan matematik pelajar.

Kedua-dua model yang digunakan MLR dan BLR telah dapat mengukur kesan persepsi pelajar terhadap matematik, pembelajaran aturan kendiri dan kemahiran berfikir terdapat responden yang dibahagikan kepada pelajar berkemampuan metematik yang lemah dan tinggi. Analisis varians (ujian ANOVA) bagi model regressi linear berganda menunjukkan signifikan yang tinggi $[F_{(1, 456)} = 73.912, p < .001]$. Hal ini mengawal kemungkinan kesalahan jenis I dengan kesan saiz yang sederhana pada ukuran lebih daripada 90 peratus ($R^2 = 0.722$). Manakala analisis regressi logistik menunjukkan bahawa lapan daripada 13 model jangkaan yang digunakan adalah signifikan secara statistik, χ^2 (15, N = 473) = 287,55; $p < 0.001$. Ini menunjukkan model yang digunakan mampu membezakan responden daripada kumpulan keupayaan tinggi dan kumpulan keupayaan rendah. Secara keseluruhan, model ini menjelaskan 45.6% (Cox & Snell R^2) dan 64.5% (Nagelkerke $\widetilde{R}^2$) dari varians dalam konstruk keupayaan matematik para pelajar sarjana muda. Model ini juga berjaya mengelaskan 85.4% daripada kes.

Analisis secara keseluruhan mendapati, 12 pembolehubah bebas memberikan sumbangan yang signifikan secara statistik yang unik pada model linear berganda manakala hanya sembilan pembolehubah bebas yang menyumbang secara signifikan pada model regresi logistik binari. Jangkaan yang terkuat terhadap pencapaian matematik adalah persepsi mengenai matematik dengan catatan nisbah ganjil sebanyak 2.58. Berdasarkan dapatan kajian ini dicadangkan bahawa kajian berbentuk longtudinal adalah perlu untuk mengukur pengaruh persepsi individu terhadap matematik ke atas kemampuan matematik pelajar. Tambahan pula, pembelajaran aturan kendiri dan kemahiran berfikir mempunyai perkaitan yang melibatkan interaksi kompleks dan dinamik antara pembolehubah–pembolehubah kognitif dan afektif.

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Delight yourself in the Lord and He will give you the desires of your heart.

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I certify that an Examination Committee has met on ---------- to conduct the final examination of Velo Suthar on his Doctor of Philosophy degree, thesis entitled "Predictive models of students' mathematical beliefs, self-regulated learning and thinking skills on mathematics ability of university undergraduate students" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the degree of Doctor of Philosophy.

Members of the Examination Committee are as follows:

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as followed:

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Date:

DECLARATION

I hereby declare that the thesis is original work except for quotation and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently submitted for other degree at Universiti Putra Malaysia or at any other institution.

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VELO SUTHAR

Date: 29 December 2010

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