



澳門大學

UNIVERSIDADE DE MACAU

教育學院

Faculty of Education

課程與教學專業碩士論文

Thesis for Master in Curriculum and Instruction

澳門 15 歲學生在 PISA2003 數學素養表現透析

An in-depth of mathematical literacy performance of Macao's

15-year-old students in PISA2003

學生：雷淑惠

Submitted by: Loi Sok Wai

指導教授：張國祥教授

Supervisor: Prof. Cheung Kwok Cheung

目錄

摘要	2
感言與謝誌	7
附圖目次	10
附圖表次	13
第一章 緒論	
第一節 研究背景與動機	16
第二節 研究目的	20
第三節 研究問題	20
第四節 名詞釋義	21
第五節 研究範圍	22
第六節 研究限制	22
第二章 文獻探討	
第一節 OECD/PISA 評估的概要和測試數學素養的涵意	23
第二節 澳門、內地和香港的數學課程大綱分析	35
第三節 性別差異和認知成份分析之相關文獻探討	46
第三章 研究方法與步驟	
第一節 研究架構	50
第二節 研究對象及工具	51
第三節 研究程序	56
第四節 資料處理與分析	57
第四章 研究結果與討論	
第一節 澳門 15 歲學生於 PISA2003 數學素養的表現	59
第二節 澳門 15 歲男生和女生於 PISA2003 數學素養的表現	76
第三節 PISA2003 數學公開題目的分析	106

第五章 結論與建議	
第一節 研究結論	117
第二節 建議	121
參考文獻	125
附錄	132



摘要

本研究的主要目的是：(1) 探討澳門 15 歲學生在 PISA2003 的數學素養表現，其中以數學的四個子範疇、學生的性別和學生就讀的年級來劃分。(2) 分析澳門 15 歲學生在 PISA2003 公開題目的數學素養表現，了解他們的優勢和弱勢。(3) 探討何種認知成份較能預測 PISA2003 公開題目的難度變異。(4) 探討學校和教育當局如何利用 PISA2003 的結果去導引澳門的數學教育。

為達到上述之研究目的，本研究對 PISA2003 澳門 1250 名 15 歲學生所測試得的數據、公開的題目和認知成份，通過統計軟體 SPSS 和 Microsoft Excel，顯示數據的圖像方法 QQplot 進行分析，從而得到以下幾點結論：

壹、澳門學生的數學素養表現較理想

澳門 15 歲學生在 PISA2003 的數學素養表現較為理想，平均分是 527.27 分，標準差為 86.95，較三十個 OECD 成員國的平均值 500 分為高，標準差 100 為低，大約高三分之一澳門的標準差。整體而言，在數量方面表現較好，其次是不確定性，繼而是空間與圖形，表現較弱的是改變與關係。

貳、澳門學生的數學素養表現，隨著年級的增加而越優秀

澳門 15 歲學生在 PISA2003，數學素養表現較好的是 10 年級的學生，無論是空間與圖形、改變與關係、數量和不確定性都是表現最好的，其次是 9 年級、8 年級，7 年級的學生則是 5 個級別中表現最差的，11 年級則是由於抽樣的學生人數較少，標準誤會較大，因此 11 年級的數學素養很取決於受試那三個學生的表現。

參、澳門男生的數學素養顯著優於女生 ($p<0.05$)

總括而言，澳門的男、女生在 PISA2003 的數學平均分分別是 538.19 分和 516.94 分，都較 OECD 成員國的平均值 500 分為高，男生比女生高 21.26 分，約為四分之一澳門的標準差，在統計上是有顯著差異 ($p<0.05$)。以平均分整體而言，男生的數學素養表現是優於女生，但從 4 個子範疇分析，男生在低分區未見有明顯的優勢，特別是在不確定性，其次是數量，女生不見得較男生為差。

肆、澳門的高數學素養表現學生多於低表現學生

澳門 15 歲學生的數學素養大部份都是屬於中間水平，大約有 70.09%，18.71% 為高表現學生，11.21% 是低表現學生。

伍、改變與關係是澳門學生的弱項

在 PISA2003 中，不論是從學生就讀的年級、數學四個子範疇、精練水平百分比或學生的不同性別來分析，澳門學生都是以改變與關係較弱，比較有優勢的是在數量及不確定性方面。

陸、解難和認知類別較能預測 PISA2003 的題目難度變異

就解難和認知類別兩個認知成份的層次，共同能預測大約 60.2% 的難度係數，說明題目在以上的認知成份層次越高，澳門的學生越感到困難。

根據以上的研究結果，對教師、教育機構和教育當局提出建議，以作參考之用。

Abstract

The purposes of this study are: (1) to explore the mathematical literacy performance (MLP) of Macao students who are in the age of 15 in 2003 Programme for International Student Assessment (PISA). The performance is assessed dividedly according to the four mathematical minor areas, students' gender and the forms those students study in. (2) To analyze the MLP of those students in public questions in 2003 PISA in order to identify their superiority and inferiority. (3) To explore which cognitive component can better predict the variety of difficulty of public questions in 2003 PISA. (4) To explore how schools and educational government can use the result of 2003 PISA to lead the education of mathematics in Macao.

To achieve the above research purposes, the data, public questions and cognitive component obtained from 1250 Macao students in the age of 15 in 2003 PISA were analyzed through SPSS, QQplot and Microsoft Excel. The findings of this study are summarized as the follows:

(1) The MLP of Macao students is more desirable

The MLP of Macao students in the age of 15 is more desirable, obtaining the average mark of 527.27 points with standard deviation of 86.95. It ranks higher than 30 countries of OECD, which obtains the average mark of 500, and lower than their standard deviation of 100, which exceeds about one third of the standard deviation in Macao. In general, Macao students perform the best in "Quantity", better in "Uncertainty", less well in "Space and Shape" and the least well in "Change and Relationship".

(2) The MLP of Macao students is higher when the forms of those students are higher

Among the Macao Students in the age of 15, students in the tenth form perform the best in all areas including “Space and Shape”, “Change and Relationship”, “Quantity” and “Uncertainty”. The MLP of students in the ninth form, the eighth form decreases progressively. The MLP of students in the seventh form is the lowest among the five forms. As the number of sample students in the eleventh form is smaller, which leads to higher standard deviation, the MLP of students in the eleventh is decided by the performance of the three students.

(3) The MLP of boys is superior to girls

The Mathematics average mark of boys and girls in 2003 PISA are 538.19 points and 516.94 points respectively. They are all higher than the average mark of countries in OCED, which is 500 points. Boys exceed girls with 21.26 points, which is about one quarter of student deviation in Macao and also shows significant difference on statistics ($p < 0.05$). According to the average mark in general, the MLP of boys is superior to girls. However, to analyze from the four minor areas, boys have no significant superiority in the area of low mark, especially in “Uncertainty” and “Quantity”, which follows next. Girls do not perform worse than boys.

(4) There is a higher proportion of students with high MLP than low MLP

About 70.09 % of Macao students in the age of 15 belong to medium level. 18.71% are with high MLP while 11.21% are with low MLP.

(5) “Change and Relationship” is the weakness of Macao students

In 2003 PISA, Macao students are weak at “Change and Relationship” in all different analysis from the forms students study in, the four mathematical minor areas, percentage of proficiency level and different gender of students. They are better at “Quantity” and “Uncertainty”.

(6) Problem solving and cognitive component can better predict the variety of difficulty of questions in 2003 PISA.

Both problem solving and two levels of cognitive component can predict the coefficient of difficulty at about 60.2 %, which illustrates that Macao students will feel more difficult if the questions require higher cognitive component.

According to the findings, there are several recommendations made for teachers, school administrators and the local government toward education policy-making.