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高中學生科學實用智能評量及其與學校表現關係之研究  
The Assessment of Practical Intelligence on Science and its Relations to  
School Performance by High School Students

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中文摘要

本研究旨在發展高中學生科學實用智能的評量工具，並探討普通生和資優生的科學實用智能與學校表現之關係，研究對象為臺灣地區公立高中高一及高二的普通生和資優生。本研究共分成兩個部分，分別為科學實用智能之評量研究及科學實用智能與學校表現之關係研究。

在研究一中，研究者編製「科學實用能力測驗」及「科學見識量表」兩套評量工具。「科學實用能力測驗」的內容包括數學和自然兩部分，由十位專家審核建立內容效度，並以與其他性向測驗之相關、分測驗間之相關和團體差異分析等方式建立構念效度；信度部分則以內部一致性和重測方式來建立；本測驗並以臺灣地區 1,263 位公立高中學生測驗資料建立常模。「科學見識量表」的內容包括經營自我、經營他人與經營工作，透過十六位科學領域專家的評定建立內容與構念效度，並以與其他性向測驗之相關、分量表間的相關、驗證性因素分析、團體差異分析、大專生科學見識得分與表現測量之相關等方式建立構念效度與效標關連效度；信度部分則以內部一致性和重測方式來建立；本量表並以臺灣地區 1,208 位公立高中學生得分資料建立常模。

在研究二中，根據 Sternberg 所提之實用智能的理論，提出包括科學實用能力及科學見識的科學實用智能與包括成就表現和學校適應的學校表現之關係模式。第一階段以結構方程模式進行 753 位高中普通班和 300 位高中資優班學生樣本的「科學實用智能與學校表現關係模式」之適配度考驗，結果發現雖有部分資料未達理想值，但整體上理論模式與觀察資料可以適配。第二階段利用逐步設限的巢套模型來檢驗兩組樣本在各種恆等假設下模式適配度的變化，結果發現普通班和資優班學生的科學實用智能與學校表現關係模式並不相同，除了潛在自變項的觀察變項之誤差變異外；將兩種樣本之原始模式分別依據統計分析結果所建議的修正指標予以修正，修正後之模式適配度考驗

結果，發現仍是模式的外在品質優於其內在品質，模式的修正對於實際觀察資料有更好的解釋力，但是實際上保留之變項的參數估計值與先前的差異不大。

依據兩個研究的結果，獲得以下結論：(1)「科學實用能力測驗」為具有信效度之評量工具，可用以評量高中學生應用數學及自然科學的原理原則解決真實生活中問題之能力；(2)「科學見識量表」為具有信效度之評量工具，可用以評量高中學生在科學領域的見識；(3)普通班和資優班的科學實用智能與學校表現關係模式並不相同；資優班學生成就表現的觀察指標較具多樣性，包括數理和非數理的基本學測與競賽表現；科學實用能力與成就表現有高度的關係，但對學校適應則無顯著的影響；具有如科學專家般地處理事務之見識，對於成就表現並無影響，但對普通生而言其學校適應會較為良好；普通生的科學實用能力與科學見識之間並無顯著相關，而資優生的科學實用能力與科學見識之間有顯著低相關。

中文關鍵字：實用智能、見識、高中學生、資優學生

#### 英文摘要

The purposes of this study were twofold: (1) to develop instruments for measuring practical intelligence, and (2) to explore the relationship between practical intelligence on science and school performance by high school students. Participants consisted of regular students from grades 10 to 11 in public high schools as well as their gifted peers.

The “Practical Science Ability Test”(PSAT) and the “Inventory of Tacit Knowledge on Science”(ITKS) were developed and standardized for the purpose. In PSAT, there involve math and science subtests. Both content validity and discriminative validity were established for the PSAT, and its internal consistency and test-retest reliability were found acceptable. The PSAT was standardized through the norm group of 1,263 high school students. The ITKS contains three subtests: managing self, managing others, and managing task. The ITKS also showed adequate content, construct and criterion-related validities, and acceptable internal and test-retest reliabilities. Based on Sternberg's theory of practical intelligence, the researcher proposed a relationship model of practical intelligence on science (i.e., practical abilities and tacit knowledge on science) and school performance (i.e., achievement and school adjustment), which was first tested on the subjects mentioned above via a structural equation modeling. The result showed that the observed data fitted the theoretical model. The model was again tested by the goodness

of fit of the subjects under different invariance hypotheses. The result revealed that the relationship between practical intelligence on science and school performance of gifted students was different from that of the regular ones. The primary models of two samples were modified, and the results showed that the modified models provided a better fit to the observed data. Main conclusions were made as follows based on the findings of the two studies:

1.The PSAT could be used to evaluate that to which extent the high school students apply principles in math and science to solve practical problems in real life;

2.The ITKS could be used to measure the tacit knowledge on science of high school students;

3.The relationship model between practical intelligence on science and school performance of gifted students was different from that of regular ones:

(1)The school achievement indicators of gifted high school students were more variable in terms of academic achievement in math, science, and other field of study and competitions than that of their regular counterparts;

(2)Gifted students' practical abilities on science were highly related to their school achievement;

(3)Though armed with tacit knowledge as perspective scientific experts, gifted students failed to show the impact of the knowledge on both achievement and school adjustment; yet for the regular students, the tacit knowledge on science did show significant impact on school adjustment;

(4)For the regular students, there involved no significant relationship between practical abilities on science and tacit knowledge; however, it did show significant but little relationship between the two variables for the gifted students.

Key words : Practical Intelligence 、 Tacit Knowledge 、 High School Students 、 Gifted Students