出國報告（出國類別：出席國際會議）

參加第 7 屆亞洲國際教育研討會 (The Seventh IAFOR Asian Conference on Education (ACE2015))

服務機關：國立嘉義大學教育系數理教育所

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前往地區：日本

出國期間：2015年10月21日至25日

報告日期：2015 年 10 月 23 日

摘要

第 7 屆亞洲國際教育研討會(The Seventh IAFOR Asian Conference on Education (ACE2015))為全球重要的教育領域相關之國際學術研討會議,每年在日本舉辦,本國際學術研討會之主辦單位包含英國、美國、日本、香港等國家之重要大學教育單位共同主辦。今年有超過 30 個國家 200 位之教育研究人員參與。本研討會之主要目的在透過國際間教育相關領域之學者於此國際研討會發表其研究團隊之研究結果,進而使得各國學者能夠進行研究與實務經驗的交流,以提升未來之研究能量。本人此次亦於大會發表論文,論文主題:*The Study of Gifted and General Fourth Graders Number Sense Performance*。論文發表之內容主要為探討國小四年級資優生與一般生在數常識之表現的差異。

關鍵詞: 一般生,日本,資優生,數常識

目次

壹、計畫目的

亞洲國際教育研討會(The IAFOR Asian Conference on Education (ACE2015))為全球重要的教育領域相關之國際學術研討會議，每年在日本舉辦，本國際學術研討會之主辦單位包含英國、美國、日本、香港等國家之重要大學教育單位共同主辦。2015 亞洲國際教育研討會的主題是：”教育，權力和權利的賦予：超越界限”(Education, Power and Empowerment: Transcending Boundaries)。本國際研討會的主要目的在透過此研討會之進行，以促進國際間教育相關領域之學者互動機會，並藉由相關研究論文成果之發表中，增進各國學者能夠進行研究與實務經驗的交流。*The Study of Gifted and General Fourth Graders Number Sense Performance*。論文發表之內容主要為探討國小四年級資優生與一般生在數常識之表現的差異。

本人參與本次國際學術研討會之主要目的有三:

一、 發表論文以與國際學者分享本人的研究發現，並讓國際學者了解臺灣目前之研究能力亦相當好。

二、 參與相關研究論文的發表，以瞭解別國學者之研究現況，同時與國際學者研討、學習及進行交流活動，以增進國際研究趨勢的了解。

三、 本次研討會有許多國際教育學者參加，透過此次研討會之

參加，希望有機會認識其他國家之學者，以瞭解目前重要學者之研究方向。

貳、參加研討會之過程與內容

2015 年 10 月 21 日搭乘長榮航空公司直飛飛機於中午 12:00 抵達日本關西國際機場，隨即轉搭公車與船前往神戶港，並於隨後前往研討會會場(神戶藝術中心)報到與領取資料，同時閱讀議程以進一步了解本會進行之內容。接著於下午 18:00-19:30 參加歡迎酒會（ACE ACSET Conference Welcome Reception [3F Grand Salon - Art Center Kobe]）。

第二天至第四天早上 9:00 報到，隨後參與各場次之報告與專題演講。參與經過說明如下：

國際會議類–會議議程、議場主題、與會參與各項研討或聽取報告議題之內容重點摘述

一、聆聽專題演講：

(一) 09:25-10:15 ACE Keynote Presentation (2F: Auditorium)
  Language Learning: Then and Now
  Eiko Kawagoe, Osaka Jogakuin University, Japan
  Introduced by Steve Cornwell, IAFOR International Programme Director of Language Learning

(二). 10:45-11:15 ACSET Featured Presentation (2F: Auditorium)
  Empowering Learners as Designers - The Rise of the Maker Movement
  Barbara Lockee, Virginia Tech, USA

二、 聆聽論文發表：

(一) *Parents' Engagement into Education of Middle-School Students with and without the Special Educational Needs Which Strategies Bring Expected Results?*
Grzegorz Szumski, Academy of Special Education, Poland
Maciej Karwowski, Academy of Special Education, Poland
Joanna Smogorzewska, Academy of Special Education, Poland

(二) *An Analysis of the Characteristics of Self-Directed Learners and Strategies to Enhance Self-Directed Learning in Education Systems: Transcending Boundaries*
Nathaniel Edwards, Yamaguchi University, Japan

(三) *Self-Assessment of Performance of Middle School Mathematics Teachers in the Light of Standards of School Mathematics Processes (NCTM)*
Fahad Alolyan, Shaqra University, Saudi Arabia

等等。

三、海報展示

The Study of Gifted and General Fourth Graders Number Sense Performance
Der-Ching Yang, Graduate Institute of Mathematics and Science Education, Taiwan
Zu-Ming Zhang, Graduate Institute of Mathematics and Science Education, Taiwan

四、與會海報主題與內容摘要

本人之海報發表在2015年10月23日下午場(13:15-14:45 Room: 606 (6F))，海報展示期間多位國際學者提問、提供意見以及對本研究發現覺得相當好，使得本人論文海報展示順利完成。個人報告主題是:*"The Study of Gifted and General Fourth Graders Number Sense Performance"*。論文發表之內容主要為探討國小四年級資優生與一般生數常識表現之研究。(海報內容如附件一)。參與活動之照片如下:
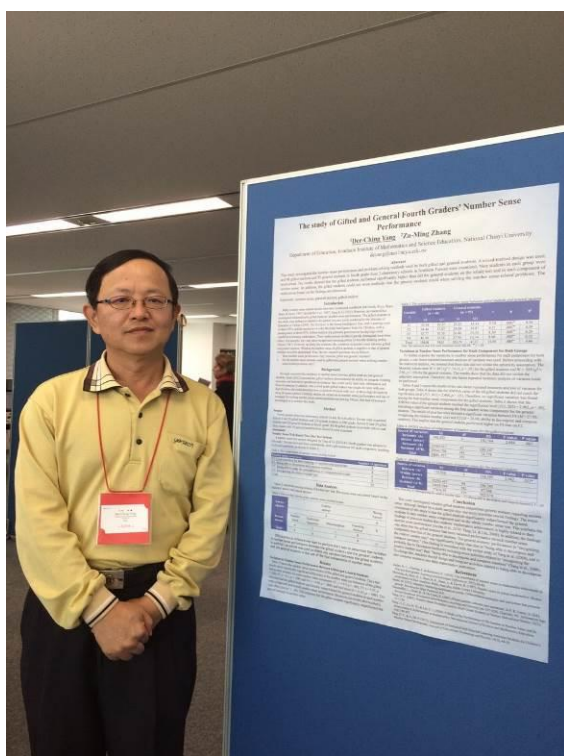
五、與會參與各項研討或聽取報告議題之內容重點摘述

個人共參與多場之報告，以下說明較有共鳴之二場報告議題之主

題、內容重點摘述如下：

（一）首先報告之主題是：An Analysis of the Characteristics of Self-Directed Learners and Strategies to Enhance Self-Directed Learning in Education Systems: Transcending Boundaries (Nathaniel Edwards, Yamaguchi University, Japan)。本主題之內容主要是探討教育系統內自我學習者之特徵與增進自我學習之策略的分析。透過自我學習是一種逐漸受重視的學習策略。此為相當有趣之研究主題。

（二）其次參與之報告是：Self-Assessment of Performance of Middle School Mathematics Teachers in the Light of Standards of School Mathematics Processes (NCTM) (Fahad Alolyan, Shaqra University, Saudi Arabia)，本文主要是探討沙烏地阿拉伯國家中學數學教師自我評量執行課程標準的表現，研究具實務性與前瞻性，對於數學教師提升自我教學效能具有鼓勵性。研究發現，值得其他國家借鏡參考。

參、與會心得

本次 ACE2015 亞洲國際教育學術研討會，主題內容包括國際重要學者之專題演講，，以及各場次之論文發表，研究結果之討論與經驗交流，內容豐富多元、生動有趣且具啟發性。透過親身參與此研討論，

多聽、多學，以瞭解其他國家數學教育學者之研究主題與方向，研究方法之發展，以及研究發現之經驗分享，本人收穫良多。

肆、建議事項

具體建議事項如下：

(一) 藉由國際性學術研討會的參與，可以提昇國內數學教育學者與碩、博士生之國際視野，同時可以進一步瞭解當前國際間數學教育領域之研究趨勢與未來可能的研究方向。因此，建議國內教育單位應該積極鼓勵國內學者與碩、博士生參與類似之國際研討會，並予以適當的補助，以增進國研究人員之國際視野。

(二) 藉由國際性學術研討會的參加，可以讓國際學者了解國內研究者目前之研究現況與實力，使臺灣學術研究能夠於國際之研討會增加能見度，進而提升臺灣於此領域之國際知名度。

附件一：

The study of Gifted and General Fourth Graders'

Number Sense Performance

[1]Der-Ching Yang   [2]Zu-Ming Zhang,
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Abstract

This study investigated the number sense performance and problem-solving methods used by both gifted and general students. A mixed-method design was used, and 48 gifted students and 95 general students in fourth grade from 2 elementary schools in Southern Taiwan were examined. Nine students in each group were interviewed. The results showed that the gifted students performed significantly higher than did the general students on the whole test and in each component of number sense. In addition, the gifted students could use more methods than the general students could when solving the number sense-related problems. The implications based on the findings are discussed.

Keywords: number sense, general student, gifted student

Introduction

Many number sense-related studies have been conducted worldwide (McIntosh, Reys, Reys, Bana, & Farrel, 1997; Verschaffel et al., 2007; Yang & Li, 2013). However, no research has investigated mathematically gifted students' number sense performance. The gifted students in this study were defined as students who passed two test levels instituted by the Ministry of Education in Taiwan (2001). The first level is the Group Intelligence Test, with a passing score of above 93%, and the second level is the Wechsler Intelligence Scale for Children, with a passing score of above 97%. Gifted students are generally perceived as having high-level capability in learning mathematics. Their mathematical abilities typically distinguish them from others. For example, they may have exceptional reasoning ability or flexible thinking ability (House, 1987). However, no study has examined the variations in number sense between gifted and general students. Whether the number sense of gifted students is superior to that of general students should be determined. Thus, the two research questions are as follows:

1. Does number sense performance vary between gifted and general students?
2. Do the number sense methods used by gifted and general students when solving number sense-related problems vary?

Background

No study examined the variations in number sense between gifted students and general students. Sands (2012) reported that gifted students demonstrated the ability to integrate thinking processes and internalize operational procedures; they could easily learn new information and discover patterns. In addition, after a third-grade gifted student was taught division with one-digit divisors, she could determine how to perform division with two- or three-digit divisors by using the same method. Currently, studies on variations in number sense performance and use of strategies for solving number sense-related questions are lacking. Hence, this lack of research encouraged us to conduct this study.

Method

Sample

Fourth graders from two elementary schools (A and B) in Southern Taiwan were examined. School A had 28 gifted students and 320 general students in fifth grade; School B had 20 gifted students and 200 general students in fourth grade. All 48 gifted students from both schools and three classes with 95 general students from School A were examined.

Instrument

Number Sense Web-Based Two-Tier Test System

A number sense test system designed by Yang & Li (2010) for fourth graders was adopted in this study. This test included four components, with eight questions for each component, resulting in 32 total questions, as shown in Table 1.

Table 1

The components of number sense testing system

Number sense components	Number of questions
F1: Understanding the basic meaning of numbers and operations	8
F2: Being able to decompose and compose numbers	8
F3: Being able to judge the reasonableness of computational results	8
F4: Recognizing the relative number size	8
Total	32

Data Analysis

Table 2 reports the scoring criteria of the two-tier test. The scores were

calculated based on the students' answer and reason choices.

Table 2

The scoring criteria of the number sense testing system

Answer choices	Correct Answer				Wrong Answer
	4				0
Reason choices	Number Sense	Traditional Operation	Misconception	Guessing Answer	0
	4	2	1	0	
Total	8	6	5	4	0

SPSS statistical software was used to perform the *t* test to determine the variation in number sense performance between the gifted students and the general students. In addition, an ANOVA was used to detect any variation between the gifted students and the general students in the use of the four components of number sense.

Results

Variation in Number Sense Performance Between Gifted and General Students

Table 3 reports the number sense performance of the gifted and general students. The *t* test results show statistically significant differences in the number sense performance of the gifted and general students for each number sense component (F1: $t = 9.5$, $p < .000$; F2: $t = 9.51$, $p < .000$; F3: $t = 8.3$, $p < .000$; and F4: $t = 8.96$, $p < .000$) and total score ($t = 11.65$, $p < .000$). This indicates that the gifted students significantly outperformed the general students in each number sense component and overall number sense performance. Moreover, the results also reached a high effect size ($\eta^2 = .44$). This indicates that the gifted students significantly outperformed the general students in number sense.

Table 3

The statistical analysis of number sense between gifted students and general students

Variables	Gifted students (n = 48)		General students (n = 95)		t	p	η^2
	M	SD	M	SD			
F1	45.48	10.57	25.29	14.43	9.50	.000**	0.34
F2	48.46	13.67	24.08	14.87	9.51	.000**	0.39
F3	43.77	10.36	26.46	14.15	8.30	.000**	0.29
F4	46.38	10.38	27.95	13.74	8.96	.000**	0.32
Total	184.08	34.01	103.79	47.17	11.65	.000**	0.44

Variations in Number Sense Performance for Each Component for Both Groups

To further examine the variations in number sense performance for each component for both groups, a one-factor repeated measures analysis of variance was used. Before proceeding with the statistical analysis, we ensured that these data did not violate the sphericity assumption. The Mauchly values were W = .847 (χ^2 = 7.613, $p > .05$) for the gifted students and W = .969 (χ^2 = 2.90, $p > .05$) for the general students. The results show that the data did not violate the sphericity assumption. Therefore, the one-factor repeated measures analysis of variance could be performed.

Tables 4 and 5 report the results of the one-factor repeated measures analysis of variance for both groups. Table 4 shows that the ANOVA value of the 48 gifted students did not reach the significance level [$F(3, 141) = 2.444$, $p > .05$]. Therefore, no significant variation was found among the four number sense components for the gifted students. Table 5 shows that the ANOVA value of the general students reached the significance level [$F(3, 282) = 2.962$, $p < .05$], indicating a significant variation among the four number sense components for the general students. The results of post hoc tests showed a significant variation between F4 ($M = 27.95$; recognizing the relative number size) and F2 ($M = 24.08$; ability to decompose and compose numbers). This implies that the general students performed higher on F4 than on F2.

Table 4

ANOVA analysis of components of number sense for the gifted students

Source of variation	SS	df	MS	F value	P value
Between (A)	548.292	3	182.764	2.444	.067
Within (error)					
Between (B)	13589.917	47	289.147		
Residual (A*B)	10543.708	141	74.778		
Total	24681.917	191			

Table 5

ANOVA analysis of components of number sense for the general students

Source of variation	SS	df	MS	F value	P value
Between (A)	775.516	3	258.505	2.962	.033*
Within (error)					
Between (B)	52292.447	94	556.303		
Residual (A*B)	24608.984	282	87.266		
Total	77676.95	379	902.074		

Note. Post-hoc: F3 (Recognizing the relative number size) > F2 (Being able to decompose and compose numbers).

* < .05

Conclusion

This study investigated whether gifted students outperform general students regarding number sense. Although limited by a small sample size, our study provides crucial findings. The major conclusion of this study is that the gifted students significantly outperformed the general students in each number sense component and on the whole number sense test. This confirms the findings of previous studies that students' mathematics achievement is highly related to their number sense performance (Jordan et al., 2010; Yang, Li, & Lin, 2008). In addition, the findings also show that the gifted students had more balanced performance on each number sense component than that of the general students. The general students' performance in "recognizing the relative number size" was significantly higher than that in "being able to decompose and compose numbers." This finding is consistent with the earlier study of Yang et al. (2008), and is probably due to Taiwanese textbooks including more activities related to "recognizing the relative number size" than "being able to decompose and compose numbers" (Yang et al., 2008). To change this, teachers should design and integrate activities related to being able to decompose and compose numbers into their mathematics instruction.

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附件二

The Seventh Asian Conference on Education

October 21-25, 2015

Organized by the International Academic Forum in affiliation with our global university partners.
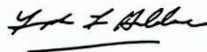
Held at Art Center Kobe

Poster Presentation Certificate

Der-Ching Yang
(National Chiayi University, Taiwan)

has presented the paper entitled:

The Study of Gifted and General Fourth Graders Number Sense Performance

This is to confirm that Der-Ching Yang (18422), having presented the above paper, actively participated in The Seventh Asian Conference on Education, and thereby contributed to the academic success of the event.

Dr. Joseph Haldane
President
The International Academic Forum

Prof. Stuart D.B. Picken
Chairman
The International Academic Forum