出國報告（出國類別：出席國際會議）

參加 2016 年亞洲教育與國際發展研討會(The Asian Conference on Education & International Development 2016)

服務機關：國立嘉義大學教育系數理教育所
姓名職稱：楊德清教授
前往地區：日本
出國期間：2016年04月01日至06日
報告日期：2016年04月05日

摘要

2016年亞洲教育與國際發展研討會(The Asian Conference on Education & International Development 2016)為亞洲重要之國際教育相關學術研討會議，今年在日本神戶舉辦，協辦單位包含歐美亞等 30 幾個著名大學。本研討會之主要目的在促進國際間教育領域之學者互動，期盼透過此研討會所發表之相關議題的進行，使各國學者能夠進行研究與實務經驗的交流。本人此次亦於大會發表論文，論文主題：”The Development and Application of Number Sense Three-Tier Test for Fourth Graders”，論文發表之內容主要為報告國小四年級學生數常識三階段診斷測驗之結果。同時亦帶領本人指導之國際學生印尼籍的 Iwan Sianturi 進行口頭論文發表，報告主題是:“Textbooks Comparison of Data and Probability in the Sixth Grade Mathematics Textbooks between United States and Indonesia”。論文發表之內容主要為比較美國與印尼國小六年級數學教科書在資料與機率之差異。

關鍵詞: 三階段診斷測驗；日本；教科書

目次

壹、計畫目的

2016年亞洲教育與國際發展研討會(The Asian Conference on Education & International Development 2016)為亞洲重要之國際教育相關學術研討會議，今年在日本神戶舉辦，協辦單位包含歐美亞等 30 幾個著名大學。本研討會之主要目的在促進國際間教育領域之學者互動，期盼透過此研討會所發表之相關議題的進行，使各國學者能夠進行研究與實務經驗的交流。

本人參與本次國際學術研討會之主要目的有二:

一、 發表論文，論文主題：”The Development and Application of Number Sense Three-Tier Test for Fourth Graders”，論文發表之內容主要為報告國小四年級學生數常識三階段診斷測驗之結果。

二、 帶領本人指導之國際學生印尼籍的Iwan Sianturi進行口頭論文發表，報告主題是:“Textbooks Comparison of Data and Probability in the Sixth Grade Mathematics Textbooks between United States and Indonesia”。論文發表之內容主要為比較美國與印尼國小六年級數學教科書在資料與機率之差異。

貳、 參加研討會之過程與內容

2016年4月1日搭乘中華航空公司直飛飛機於晚上7:55抵達日本大阪關西國際機場，經過漫長的排隊入關，於晚上11點抵達大阪住宿旅館。隨後前往日本神戶藝術中心研討會會場報到，並參加下午場之研討會活動。接著於4月5日參加當日之研討會活動，活動說明如下：

一、研究生論文發表

本人指導研究生之論文口頭報告於上午9:00~9:30進行。本場次共有三篇文章發表，主題內容說明如下:

Tuesday Session I: 08:30-10:00 Room: 505 (5F)

Primary & Secondary Education

Session Chair: Benyapa Prachanant

(1)22134 08:30-09:00

Realistic Mathematics Education: An Approach for Overcoming Math Anxiety of Junior High School Students in Semarang, Indonesia

Shofiayuningtyas Luftiani Yusuf, Monash University, Australia

(2)22622 09:00-09:30

Textbooks Comparison of Data and Probability in the Sixth Grade Mathematics Textbooks Between the United States and Indonesia

Iwan Sianturi, National Chiayi University, Taiwan

Der-Ching Yang, National Chiayi University, Taiwan

(3)27087 09:30-10:00

The Perception of Science Secondary School Teachers Towards the Science Learning

Problems of Lower Secondary School Students in Thailand
Benyapa Prachanant, Srinakharinwirot University, Thailand
Parin Chaivisuthangkura, Srinakharinwirot University, Thailand
Kamonwan Kanyaprasith, Srinakharinwirot University, Thailand

二、本人之論文發表(12:45~14:00)
Tuesday Session III: 12:45-14:15 Room: 504 (5F)
22400
The Development and Application of Number Sense Three-Tier Test for Fourth Graders
Der-Ching Yang, National Chiayi University, Taiwan
Ming-Chieh Yu, National Chiayi University, Taiwan
Mao-Neng Li, National Chiayi University, Taiwan

三、專題演講

參與之專題演講包括：

1. Featured Panel Presentation
   Japan, Education and Internationalization
   Haruko Satoh, Osaka University. Japan
   Grant Black, University of Tsukuba, Japan
   Joseph Haldane, President – The International Academic Forum, Japan
2. Spotlight Sessions
   Exchanging Knowledge and Building Communities via International Networking
   James Underwood, University of Northampton, UK

等活動

四、與會報告主題與內容摘要

(一)帶領研究生發表論文

本人指導研究生Iwan Sianturi之口頭論文發表在4月5日上午場(9:00~9:30)，報告順利完成，報告內容也引發多位國際學者餐與熱烈討論，並提供不同意見、提問與對本研究發現提供建言。此報告主題是:“Textbooks Comparison of Data and Probability in the Sixth Grade Mathematics Textbooks between United States and Indonesia”。論文發表之內容主要為比較美國與印尼國小六年級數學教科書在資料與機率之差異。參與活動之照片如下圖1：

圖1:研究生發表論文情形

(二)本人論文發表

本人之論文發表在4月5日下午場12:45~14:00，報告順利完成，討論期間也引發國際學者之建言與意見交流。個人報告主題是: The Development and Application of Number Sense Three-Tier Test for Fourth Graders”，論文發表之內容主要為報告國小四年級學生數常識三階段診斷測驗之結果。(報告內容如附件一，證明如附件二)。參與活動之照片如下圖2:

圖 2:會議情形

伍、與會參與各項研討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：印尼學者報告：*Realistic Mathematics Education: An Approach for Overcoming Math Anxiety of Junior High School Students in Semarang, Indonesia.* 本主題之內容主要是探討印尼國中生對數學普遍具有焦慮感，該研究透過真實數學的融入可以降低國中生對數學之焦慮感。本研究報告內容相當有趣亦具重要性。

(二)其次之主題是：”Exchanging Knowledge and Building Communities via International Networking”，本主題之內容主要是探討透過國際網路可以進行知識之交換與建構互動社群。藉由網路的確可以擴大各界各地之人們進行溝通與互動，進而進行知識之交換。此為相當有趣之研究主題。

參、與會心得

本次國際教育學術研討會，主題內容含括重要學者之專題演講，各種不同研究主題之報告與經驗分享，內容豐富多元、生動有趣且具多元性。藉由親身參與本國際研討會，可以瞭解其他國家數學教育學者或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，獲益良多。

肆、建議事項

透過國際性學術研討會之參與，可以提昇個人之國際視野，同時亦可瞭解當前國際數學教育界或教育界之研究趨勢與未來可能之研究方向。透過論文發表於國際性學術研討會，可以讓國際學者了解國內研究者目前之研究現況，以增強臺灣學術研究於國際之能見度，進而提升台灣於此領域之國際知名度。因此，建議國內教育單位應積極補助國內學者參與類似國際研討會，以增進國際視野。

附件一:

The Development and Application of Number Sense Three-Tier Test for Fourth Graders

Der-Ching Yang, Ming-Chieh Yu, Mao-Neng Li

Department of Education, Graduate Institute of Mathematics and Science Education

National Chiayi University, dcyang@mail.ncyu.edu.tw

Abstract

The purposes of this study were to develop and apply the number sense three-tier test for fourth graders. The number sense three-tier test for fourth graders was developed based on the earlier studies and three-tier related studies. 166 fourth graders from a public elementary school of south Taiwan were selected to join this study. The results showed that the number sense three-tier test for fourth graders has a good reliability and validity. Data also showed that sample students performed poor on number sense and there is a significant difference on number sense performance among different levels of students' performance on number sense. In addition, there is a significant difference on mathematics achievement among different levels of students' performance on number sense. Moreover, many different misconceptions were found for the sample students and the confidence index used in this study has an important meanings. Finally, the implications were discussed.

Keywords: Three-tier diagnostic test, Grade four, Number sense

Introduction

Number sense plays a key role in our daily life (Dehaene, 1997). In addition, helping children develop number sense has been highlighted internationally by many studies and reports (Berch, 2005; Dunphy, 2007; NCTM, 2000; Jordan, Raminent, & Watkin, 2010; Sood & Jitendra, 2007; Verschaffel, Greer, & De Corte, 2007; Yang & Li, 2013). Lack of number sense often leads to learning disabilities in mathematics to a certain degree (Jordan, Kaplan, Locuniak, & Ramineni, 2007; Dyson, Jordan, & Glutting, 2013). If students are able to exercise number sense flexibly will help them keep learning effects longer (Yang & Li, 2008). Inspired from the study of Haki & Ali (2010) on a valid and reliable 3-tier test to assess students' misconceptions about simple electric circuits, our current web-based two-tier test system (options + reasons) for number sense may be strengthened with an additional certainty of response index. We do hope the 3-tier test results can be a valid and reliable measure of students' qualitative understanding of number sense. The research questions are as follows:

1. Will the three-tier number sense test more reliable and valid than the 2-tier test?
2. Is there a close relationship between 4th-grader's number sense and their

performance in mathematics?

3. Is there any gap between 4th-grader's actual uses of problem solving strategies and their subjective-perception of problem solving strategies ?

Background

What is N*umber Sense?*

In general, number sense refers to a person's general understanding of numbers and operations and the ability to handle daily life situations that include numbers--i.e., developing useful, flexible, and efficient strategies (including mental computation or proficient estimation) for handling numerical problems (McIntosh, Reys, & Reys, 1992; Reys & Yang, 1998; Sowder,1992; Yang, 2013).

Number sense components

Based on the earlier studies of Yang & Li (2005, 2007), this study defined the number sense components as follows:

F1: Being able to understand the basic meaning of numbers，

F2: Being able to Recognize the relative magnitude of numbers，

F3: Being able to compose and decompose numbers flexibly，

F4: Being able to judge the reasonableness of a computational result via different

The studies of three-tier test models

The number sense three-tier test was based on the earlier studies. Pesman and Eryilmaz (2010) designed a three-tier test to assess misconceptions about simple electric circuits. Caleon and Subramaniam (2010) developed a three-tier test to assess secondary student's understanding and related misconceptions of waves. They all found that the three-tier tests not only have a good reliability and validity, but also can be used to detect students' alternative conceptions. The three-tier test in this study includes the first-tier c**onventional multiple-choice questions** (**content tier**), the second-tier **reasons for the given answer for the first-tier** (reason tier), and the third-tier certainty about the correctness of student's chosen options for the answer and the reason tiers (**confidence tier**).

Method

Sample

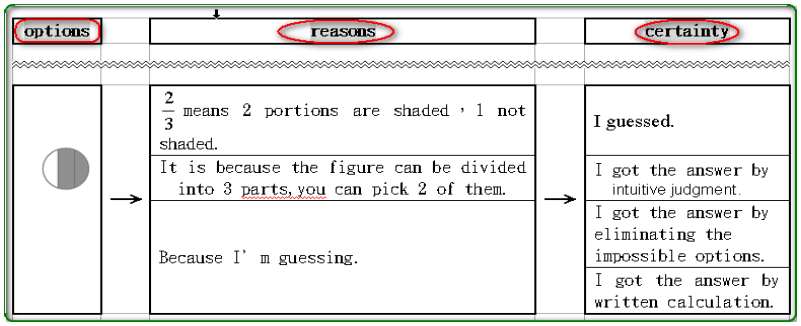
166 fourth graders from southern Taiwan were selected to join this study.

Instrument

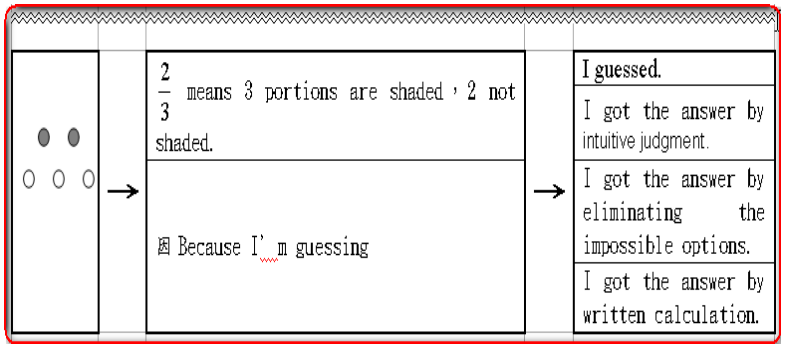
The three-tier test designed in this study included 8 items for each number sense component and 4 number sense components included in this study. Therefore, there are 32 items totally. An Example of the number sense three-tier test is described as follows:

Which of the following options indicates that the shaded area represents two-thirds of the figure?

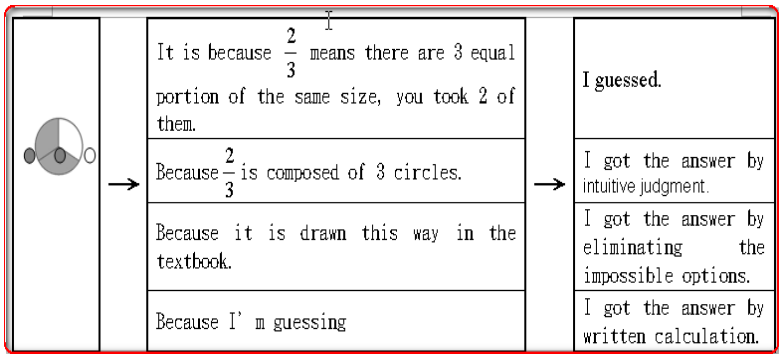
Item format & Option 1



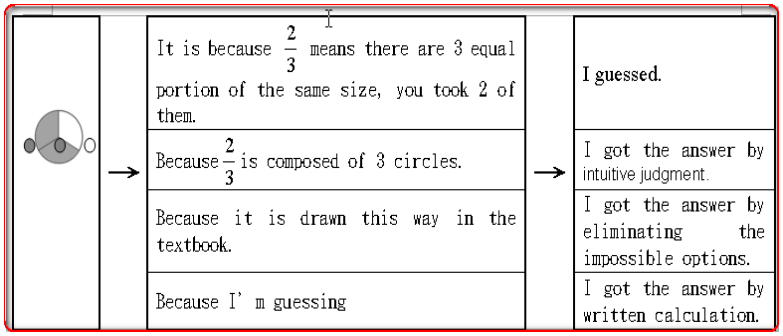
Option 2



Option 3



Option 4



Scoring rules

Table 1. Scoring rules

Answer options	Correct answer	Wrong answer
	4 points	0

Reason options	NS-based	Rule-based	Misconception	Guessing	NA
	4	2	1	0	0
Score	8	6	5	4	0

CRI	By intuition	By calculation	Eliminating	Guessing
Score	4	2	1	0

Results

Reliability Analysis for the 3-tier NS Test

Table2. Reliability analysis for the 3-tier NS test

Test type	NS Component				total
	Factor 1 (subtest 1)	Factor 2 (subtest 2)	Factor 3 (subtest 3)	Factor 4 (subtest 4)	
# of items	8	8	8	8	32
2nd stageα	.594	.697	.693	.606	.874
3rd stage α	.703	.777	.785	.734	.907

Data shows that the 3-tier test has better reliability than the 2-tier test.

Construct reliability analysis for the 3-tier NS test

Table 3. Construct reliability analysis for the 3-tier test

Test type	NS Component			
	Factor 1 (subtest 1)	Factor 2 (subtest 2)	Factor 3 (subtest 3)	Factor 4 (subtest 4)
2nd stage	.790	.850	.852	.802
3rd stage	.826	.872	.869	.845

Data shows that the construct reliability analysis for the 3-tier test is better than the 2-tier test.

Validity

The design of number sense three-tier test was based on the earlier studies (Yang & Li, 2005, 2007). The contents of the three-tier test satisfied the basic definition of number sense and three-tier test models. In addition, several mathematics educators and elementary school teachers were invited to review the contents of the three-tier

test. They all agreed that the three-tier test can be used to detect students' number sense and related misconceptions. Therefore, the number sense three-tier test has good content validity and specialist validity. In addition, results also showed that there is a positive correlation between children's NS and their performance in Math achievement (r=.661 for a 3-tier test; r=.686 for a 2-tier test, $p. < .01$). Therefore, this instrument has good criterion-related validity. Table 4. Descriptive statistics about problem solving strategies used in the NS test for correct answers

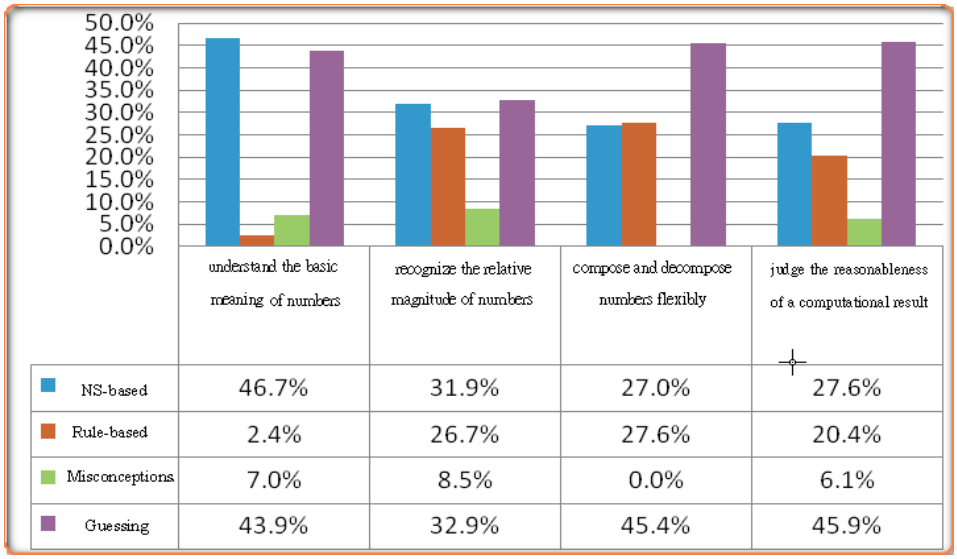


Table 5. NS levels and math performance

Components	Levels of NS	Mean	SD	N
Being able to understand the basic meaning of numbers	Low(A)	25.5714	11.87566	42
	Middle(B)	39.7143	12.94319	42
	Middle +(C)	51.5854	13.22304	41
	High(D)	67.1951	11.95872	41
Being able to recognize the relative magnitude of numbers	Low(A)	28.7381	13.20395	42
	Middle(B)	45.9286	10.64366	42
	Middle +(C)	57.6585	10.34072	41
	High(D)	72.8293	9.86129	41
Being able to compose and decompose numbers flexibly	Low(A)	22.3095	10.07651	42
	Middle(B)	35.5238	13.59562	42
	Middle +(C)	46.4390	13.31174	41
	High(D)	68.6098	14.24233	41
Being able to judge the reasonableness of a computational result	Low(A)	23.8571	10.41474	42
	Middle(B)	33.5714	11.82008	42
	Middle +(C)	47.9024	11.78729	41
	High(D)	66.2927	12.92912	41

F=82.774, p=.000; F=117.003, p =.000; F=95.605, p =.000, F=101.988, p =.000, α=.05

Post hoc comparisons (Scheffe): B>A, C>A&B, D>A&B&C.

Table 6. Correlation between reason-score and confidence score (N=166)

Correlation between reason-scores and confidence scores (N=166)

		R1	R2	R3	R4	Rtotal
C1	Pearson	.597	.433	.389	.358	.527
	p	.000	.000	.000	.000	.000
C2	Pearson	.379	.600	.450	.435	.548
	p	.000	.000	.000	.000	.000
C3	Pearson	.320	.393	.670	.405	.532
	p	.000	.000	.000	.000	.000
C4	Pearson	.347	.472	.454	.650	.565
	p	.000	.000	.000	.000	.000
Ctotal	Pearson	.485	.570	.590	.555	.650
	p	.000	.000	.000	.000	.000

Results showed that Students with high scores in reasons generally have higher confidence levels than students with low scores.

Conclusion

The 3e-tier NS test score is more reliable than the 2-tier test score. The 4th graders with various levels of NS showed a significant difference between the 4 components of NS. The 4th graders with various levels of NS showed a significant difference in mathematics achievement. Number sense is not frequently used by 4th graders. Gap between actually-used problem solving strategies and subjectively-perceived problem solving strategies. Students with high scores in reasons generally have higher confidence levels than students with low scores. There are closely related among raw scores, reason scores and confidence scores. Guessing was used very often by students with correct answers. Misconceptions were found very often by students with wrong answers.

References

Caleon, I. & Subramaniam, R. (2010). Development and application of a three-tier diagnostic test to assess secondary students' understanding of waves. International Journal of Science Education, 32(7), 939-961.

Dehaene, S. (1997). *The number sense: how the mind creates mathematics.* London: Oxford University Press.

Dunphy, E. (2007). The primary mathematics curriculum: enhancing its potential for developing young children's number sense in the early years at school. *Irish Educational Studies*, *26*(1), 5-25.

Dyson, N. I., Jordan, N. C., & Glutting, J. (2013). A number sense intervention for low-income kindergartners at risk for mathematics difficulties. Journal of Learning Disabilities, 46(2), 166-181.

Pesma, H. & Eryilmaz, A. (2010). Development of a three-tier test to assess misconceptions about simple electric circuits. The Journal of Educational Research, 103, 208-222.

Yang, D. C. & Li, M. N (2013). Assessment of Animated Self-Directed Learning Activities Modules for Children's Number Sense Development. *Journal of Educational Technology and Society, 16*(3), 44-58.

附件二

iafor
ASIA'S THINK TANK

aceid2016

22400
0416-02-03-01

The Second Asian Conference on Education & International Development

April 3-6, 2016

Organized by the International Academic Forum in affiliation with our global university partners.

Held at Art Center of Kobe
Kobe, Japan

Poster Presentation Certificate

Der-Ching Yang
(National Chiayi University, Taiwan)

has presented the paper entitled:

The Development and Application of Number Sense Three-Tier Test for Fourth Graders

This is to confirm that Der-Ching Yang (22400), having presented the above paper, actively participated in The Second Asian Conference on Education & International Development, and thereby contributed to the academic success of the event.

Dr. Joseph Haldane
President
The International Academic Forum

iafor

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