教育科學研究期刊　第五十六卷第二期
2011 年，56（2），207-240

跨年級中學生認知地圖之分析研究：以粒子行為試題為例

邱美虹
國立臺灣師範大學
科學教育研究所
教授

鐘建坪
國立臺灣師範大學
科學教育研究所
研究生

張志康
基隆市立暖暖高中
教師

白勝安
國立臺灣師範大學
科學教育研究所
研究生

摘要

本研究針對全國概念調查的結果進行次級資料分析（secondary data analysis），目的在探索中學生的認知地圖及其形成的相關限制因素。研究的分析架構是以 Hempel（1958）描述現象觀察的理論解釋與 Wellman（1994）和其他學者（Chaib-draa & Desharnais, 1998; Peña, Sossa, & Gutiérrez, 2008）詮釋因果推論的認知地圖為基礎。首先，研究者依據全國概念調查雙層診斷測驗試題內容（Chiu, 2007），找出特定概念間的相互關係；其次，透過雙層試題的語意連結，形成不同試題選項之認知地圖的質性描述；最後，分析跨年級中學生認知地圖的分布情形，藉以瞭解學生在概念發展上的差異。本研究結果指出：一、跨年級中學生正確連結理論系統與經驗觀察的人數比例，雖然隨年級增加而提高，但是比例仍然偏低。二、在相似情境試題中，跨年級中學生受到壓力、重量以及隨機性等不同限制因素的影響，會形成不同類型的認知地圖。本研究所確認的概念限制因素可解釋認知地圖在概念圖像化的因果推論關係，而以認知地圖作為次級資料分析的研究方法所產生的限制與對研究的意涵將在文末一併討論。

關鍵字：次級資料分析、概念調查、認知地圖、雙層診斷測驗

通訊作者：邱美虹，Email:mhchiu@ntnu.edu.tw
收稿日期：2010/07/19；修正日期：2011/05/05、2011/06/13；接受日期：2011/06/15。

Journal of Research in Education Sciences
2011, 56(2), 207-240

A Secondary Analysis Study of Student Conceptions on the Behavior of Gas Particles by Utilizing the Cognitive Map Approach

Mei-Hung Chiu
Graduate Institute of Science Education,
National Taiwan Normal University
Professor

Jing-Ping Jong
Graduate Institute of Science Education,
National Taiwan Normal University
Graduate Student

Chih-Kang Chang
Keelung Municipal NuanNuan Senior High School,
Keelung City
Teacher

Sheng-An Bai
Graduate Institute of Science Education,
National Taiwan Normal University
Graduate Student

Abstract

The purpose of this secondary data analysis study is to explore the cognitive maps (CMs) held by the students and their constraints of conceptions while forming their qualitative inferences regarding the behaviors of gas particles. The data used in this study was derived from the National Science Concept Learning Study via the use of two-tier diagnostic instruments proposed by Treagust (1988, 1995). Unlike other studies only comparing student performance, the analytical method of this study adapted a model of scientific explanations proposed by Hempel (1958), and cognitive maps by Wellman (1994) and others (Chaib-draa & Desharnais, 1998; Peña, Sossa, & Gutiérrez, 2008). The results are as follows: (1) although the performances of 11th graders were superior to those of 8th and 9th graders, the percentages of correct answers were still relatively low; (2) in similar contexts, due to the constraints (gravity, pressure, and randomness of motions) of factors, the students held various CMs of gas particles and causal inferences. The identified CMs of gas particles provide information regarding the constraints that students held in their mental representations. This study presents a discussion of the educational implications for designing two-tier diagnostic instruments, and the limitations of CMs.

Keywords: secondary analysis, concept survey, cognitive maps, two-tier diagnostic instrument

Corresponding Author: Mei-Hung Chiu, Email:mhchiu@ntnu.edu.tw