# 國立屏東教育大學100學年度研究所碩士班入學考試

## 文獻閱讀（科學教育類） 試題

（數理教育研究所科學教育碩士班）

**※請注意：1.本試題共三頁。**
**2.答案題號須標示清楚，並寫在答案卷上，否則不予計分。**
**3.本科考試提供電子字典查閱英文詞彙。**

一、 文章1“學習”文章談到專家如何學習。如果我們要教育學生成為專家，有必要以專家的典範，協助學生學習專家的學習特質，因此需要列出學習的證據。例如，基於「專家關注有意義的規律性」，評量學生「描述資料的規律性」或「辨識資料有意義的相似性或相異處」，而不是記誦名詞定義。想一想，還有哪些專家的特質可以轉換成判斷學習的有效證據？（25分）

### 文章 1 - 學習

我們不僅要了解科學教育的目標，更要判斷學生學習成效的證據。有些人以學習測驗或成就評量的結果來認定學生的學習成果；有些人以段考成績來決定學生的學習成效；還有一些老師以課室中學生的口語反應或書面實驗報告做為學生學習表現的證據。在林林總總不同的評量形式中，我們要用什麼準則，合理的選擇科學學習的證據？How People Learn（Bransford, Brown & Cocking, 1999）一書中，指出如下五點專家與眾不同的特質，可以做為我們判斷有效學習的原則：

1. 在面對外界訊息時，專家會注意到某些特質和有意義的規律（patterns），新手可能只會看到表面的片段訊息。例如棋奕高手舉棋前，能辨識棋盤上棋局，清楚了解各種可能性；新手卻沒有這種能力。

2. 專家積年累月的經驗，對本行的知識有深入的組織與理解。例如，物理學家會應用物理學原理（如能量守恆原理）分析問題；一般新手則以表面特性（如斜面坡度）來做反應。一般新手不僅對知識內容不解，也不懂得如何將知識有意義的組織成可理解的架構。

3. 專家的知識是「條件化」（conditionized）的－對於這些知識的適用範圍有很清楚的規範，而不是零散的片段訊息。面對問題時，專家知識如何提取特定有關的知識。以漁夫釣魚為例，漁夫知道在什麼情況（如季節、氣候、地點、時間）使用哪一種釣竿。

4. 專家可以很輕易的從腦海中提取可用的知識，例如汽車司機駕駛車輛時，駕駛技能純熟，反應迅速而且還可以注意其他事情（如與人交談）。

5. 面對新的情境或問題時，不同的專家會採取不同層次的彈性與適應性。一般而言，「工匠型」（artisan）的專家會因循舊習很快的完成工作；相反的，「藝術大師型」（virtuoso）的專家會探索和擴大自己現有的專業知識，對新的情境展現創意與高度適應的能力，而不會受限於現在的知識層面。在這種適應的歷程中，專家會深入剖析自己專業知識的限制，尋求新的知識；換言之，就是後設認知的能力。

二、 文章 2“A fish story”的主旨大意為何？這一篇文章對科學教育的啟示為何？（25 分）

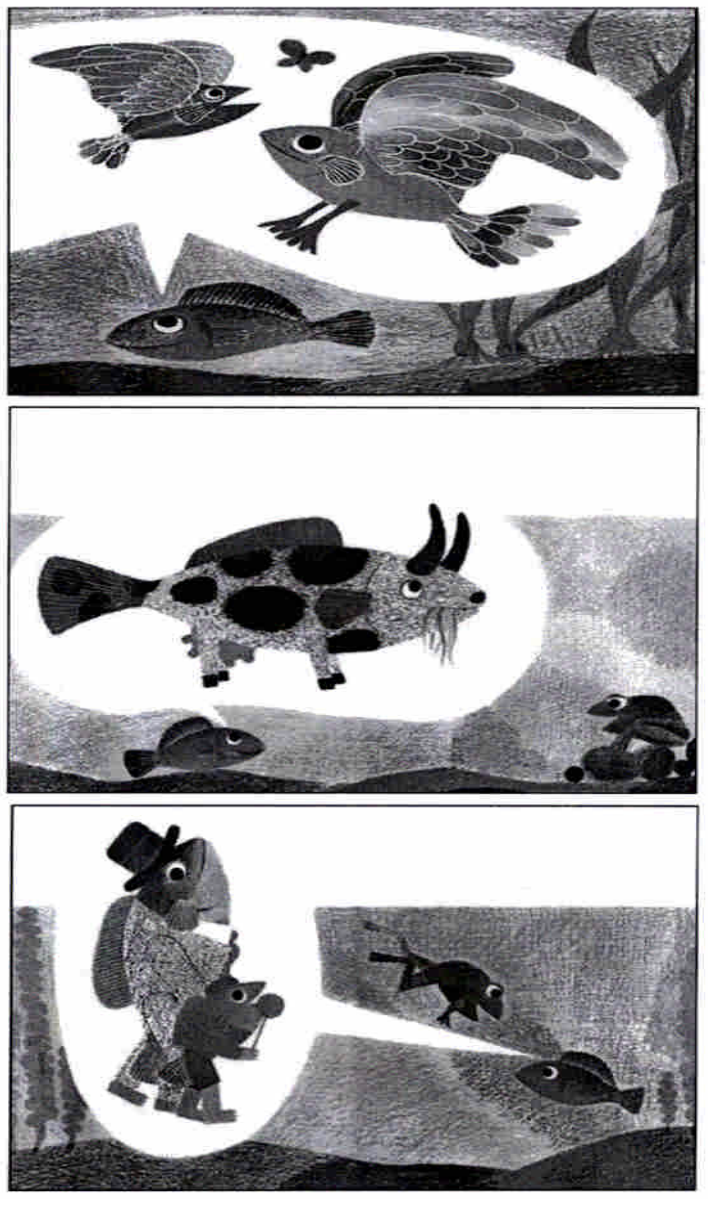
# 文章 2 - A fish story

## A FISH STORY

The images from a children's story, *Fish Is Fish*,[2] help convey the essence of the above principles. In the story, a young fish is very curious about the world outside the water. His good friend the frog, on returning from the land, tells the fish about it excitedly:

> ***"I have been about the world—hopping here and there," said the frog, "and I have seen extraordinary things."***
> ***"Like what?" asked the fish.***
> ***"Birds," said the frog mysteriously. "Birds!" And he told the fish about the birds, who had wings, and two legs, and many, many colors. As the frog talked, his friend saw the birds fly through his mind like large feathered fish.***

The frog continues with descriptions of cows, which the fish imagines as black-and-white spotted fish with horns and udders, and humans, which the fish imagines as fish walking upright and dressed in clothing. Illustrations below from Leo Lionni's *Fish Is Fish* © 1970. Copyright renewed 1998 by Leo Lionni. Used by permission of Random House Children's Books, a division of Random House, Inc.



三、 請閱讀以下英文摘要，說明此研究的內容與結論。（50 分）

※專有名詞中英文對照如下：

- Argumentation：論證
- Cognitive development：認知發展
- Socioscientific：社會性科學議題相關的
- Schema：基模、框架
- Microanalysis：微分析（檢視教學錄影來分析教學活動過程）

# Arguing to Learn and Learning to Argue: Case Studies of How Students' Argumentation Relates to Their Scientific Knowledge

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Abstract: In this study we investigated junior high school students' processes of argumentation and cognitive development in science and socioscientific lessons. Detailed studies of the relationship between argumentation and the development of scientific knowledge are rare. Using video and audio documents of small group and classroom discussions, the quality and frequency of students' argumentation was analyzed using a schema based on the work of Toulmin (1958). In parallel, students' development and use of scientific knowledge was also investigated, drawing on a schema for determining the content and level of abstraction of students' meaning-making. These two complementary analyses enabled an exploration of their impact on each other. The microanalysis of student discourse showed that: (a) when engaging in argumentation students draw on their prior experiences and knowledge; (b) such activity enables students to consolidate their existing knowledge and elaborate their science understanding at relatively high levels of abstraction. The results also suggest that students can acquire a higher quality of argumentation that consists of well-grounded knowledge with a relatively low level of abstraction. The findings further suggest that the main indicator of whether or not a high quality of argument is likely to be attained is students' familiarity and understanding of the content of the task. The major implication of this work for developing argumentation in the classroom is the need to consider the nature and extent of students' content-specific experiences and knowledge prior to asking them to engage in argumentation.
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**Keywords:** general science; discourse analysis; conceptual change; middle school science; classroom research