加拿大中学数学教师的数学教学知识和发展

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Outline

- My background
- Canadian mathematics teachers' knowledge & its development
- Conclusion & implication

My Background

- Education: 2-Bsc, MSc, Ph.D.
- Research: students' performance, teachers' knowledge & development, comparison curriculum, problem solving
- Teaching: China, the US & Canada, teach secondary & undergraduate math & stats.& educational courses
- Interests: cognition, learning theories

Math Teachers' knowledge and Development: Introduction

- Mathematics teachers' professional development and effects
- Research on mathematics teachers' knowledge and categories

Context of Ontario Education System

- Canadain Education Systems
- Changes of Ontario Education System
- Consequences of these Changes
- Ontario Mathematics Curriculum Reforms

Literature Review (1)
Models of Teachers' Knowledge

Shulman	SMK, Cr.K, PCK
Ball et al. (2008)	SMK (CCK, SCK, HCK), PCK (Content & (Cr.K, KS, Instruction))
Baumert et al. (2010)	SMK (Secondary Curr. in Germany), PCK (Tasks, KS, & Instruction)
Fennama & Franke (1992)	SMK (Math), KS & Cognition, Pedagogy
Rowland (2005)	Quartet: Foundation, Transformation, Connection & Contingency

Similarity: These Models (2)

- Primary components in teachers' knowledge models:
  - --Subject matter knowledge (SMK);
  - --Pedagogical content knowledge (PCK)
  - --Curriculum knowledge (CK)
  - --Knowledge of students (KS)
- Teachers' learning & professional development
  - -- Formal and informal learning

Differences of These Models

- SMT
- Knowledge of Curriuclum
- Knowledge of Students
- Pedagogical Content Knowledge

My Research focii: Teachers' Knowledge

- SMK
- Knowledge of Curriculum
- Knowledge of students' misconceptions
- Pedagogical content knowledge
- Teachers' PD

Research Questions

- How do secondary school math teachers develop their knowledge?
- How do they understand secondary math?
- What are their perspectives on the secondary math curriculum?
- How they recognize students' misconception in mathematics?
- What is their mathematical pedagogical content knowledge (teaching)?

Research Design - (1)

- Three case studies
- Participants: Ron, Alan, and Hardy

参与者	本科学学习科目	教育学位	工作学校	学生升学率	职后学习
Ron（罗恩）	滑铁卢，数学（教育）	西安大略大学	私立	99%（本科）	教育硕士，教育部门组织的培训
Alan（艾伦）	多伦多大学，数学（应用）	多伦多大学	公立	不详	学校或教育部门组织的培训
Hardy（哈迪）	多伦多大学（生物）	皇后大学	公立	不详	学校或教育部门组织的培训

Research Design-(2)

- Data collection:

  Semi-structured interviews, documents they wrote, websites they designed & used, class observations & fields notes, video recording, textbooks, official curricula

- Data analysis:

  Cross case comparison

Research Protocol Development

- SMT
- Knowledge of Curriuclum
- Knowledge of Students
- Pedagogical Content Knowledge
- Teachers' Professional Development

Design: Math Content Knowledge

- 概念性知识的理解
- 数学的思维方法
- 解题的步骤和方法
- 例如：

1. 在不等式$|2x-5|<9$，有多是个整数解？
2. 化简：$\sqrt{\sin^4 x+4\cos^2 x}-\sqrt{\cos^4 x+4\sin^2 x}$

Design: Math Curriculum

1）教师对省和学校课程的看法，包括课程对学生知识发展，认知和未来继续学习的正向或负向的影响。

2）他们如何弥补课程中的缺失或没有强调的内容，这些内容对后继课的学习是必要的基础知识。

3）教师如何选择教学内容

4）教师处理课程中没有重点强调的数学的核心内容

例如1，给出关系：三角形的面积，矩形的面积，梯形的面积，正多边形的面积，和微积分黎曼和的关系。

Design: Identify Students' Mistakes

- 测定教师对学生学过的知识或错误概念的评估
- 例如：学生在计算中使用 $(x+y)^2 = x^2 + y^2$，$2^{x+y} = 2^x + 2^y$，$2^{ab} = 2^a \bullet 2^b$

Design: Teaching (PCK）

- 测定教师的教学法

1. 5个数学主题设计在这里。
2. 例如：

1） 在教代数表达式前如何引入变量这个概念？

2） 如何教多项式的除法运算？

Design: Professional Knowledge Development

- 探讨教师时如何从一个新教师到本学校的学科带头人，也即是他们专业知识发展的轨迹
- 设计了9 个方面的问题

例如：个人的背景，谁影响他们的教学，对各类学校（大学，教育学院）看法等等。

Findings (1): PD-Learning Trajectories

- Self-monitoring, reflection
- Trajectories: experience (teaching, learning & observation), students, workshops, conferences, Internet, peer teachers, courses & activities, curriculum changes, school environment, expectations.

Findings (2)—SMK

- Content interview results
- Connections (topics, strands, and fundamental ideas), concepts and procedures/algorithms
- Ability to remain current

Findings (3)—Cr.K

- Official curriculum: strengths, weaknesses
- Topics distributions or suggested teaching methods
- Curriculum materials: textbook is not sufficient, supplementary content, select technology

Findings (4)—KS

- Understanding their students

  1. Their lives and expectations

  2. Recognize students' different abilities in mathematics

- Students' mathematics misconceptions

  1. Students' prior knowledge

  2. Students' learning experience (real life context)

  3. Check students' problem solving procedures

Findings (5)—PCK-Teaching

- Teaching strategies
  1. Reorganization and Rationale
  2. Socratic lessons
  3. Differentiated teaching
  4. Using technology
- Teachers' reflection
  1. Adjust content
  2. Alternative approaches
- PCK integrates SMK, Cr.K, KS,& math pedagogy

Conclusion

- SMK & Official and School Curricula
- Curriculum knowledge: know strengths & weaknesses, supply content
- Understand students
- Teaching
- Individual PD: self-monitoring & self-preference

Implication

- Preservice teacher programs
- Inservice programs: materials, refresh SMK, update PCK, observing experts' lessons, resources & approaches for PD
- Mathematics curriculum reforms

Future Research

- Teachers' knowledge for teaching
- How to develep teachers' professional knowledge
- The impact curriculum standards on teachers' PD

B.F. Skinner

Education is what survives when what has been learned has been forgotten.

Thank You!

Questions?

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