An outsider's

Reflections on the Graduate School in Mathematics Education

The Swedish Graduate School in Context

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Overview

- The (modern) PhD – young and evolving
- *Selected* International Perspectives
  1. The USA
  2. The UK
  3. Australia
  4. Sweden
- New directions
- The Swedish Graduate School in mathematics Education
  1. Scope
  2. Report card

The PhD[1]

1st PhD: University of Bologna - 12th Century

(Doctor of Civil Law and Doctor of Canon Law)

At that time

- **The only qualification conferred**
- **"A license to teach" but**
- **Not a higher research degree**
- **Medieval university: No equivalent to the modern PhD**

The Modern PhD

19th century German innovation:
→ a post graduate degree ≥ *6 years of specialized study, guidance by professor* → internationally attractive

1st American PhD: 1861 - Yale University → proliferation; variable quality

1st PhD in Great Britain: 1917 - Oxford University; 1919 Cambridge follows

1st PhD in Australia (University of Melbourne) – 1948

The PhD$_2$

20th Century - The PhD

Dissertation **based on ~3 years of research (4 years in Sweden) + *written/oral tests at discretion of examiners***

…symbol of the modern era of organized training in research– conceived and nurtured in Germany, imported and commercialized in America and finally introduced into Britain to wean the latter's students away from the former's universities. (Simpson, 1983, p. 159)

The PhD

“essentially, a PhD is a training and apprenticeship in research, a period of learning the tricks of the trade, of becoming a professional, and of establishing yourself as a peer among experts” (Park, 2005)

The PhD_3

Reflection on a Graduate School

WHAT TO AVOID

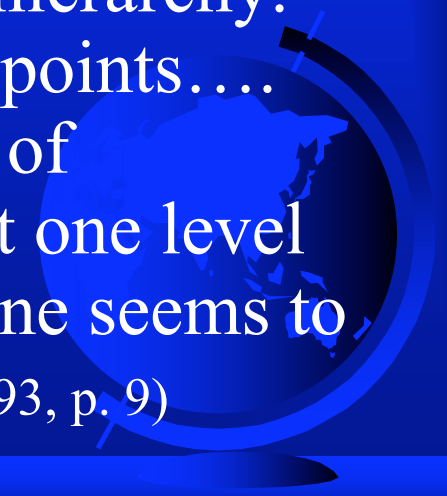
At ANU we converted to a Graduate School in 1990. There were good reasons for the conversion; but we added the new, and the old structures continue. We now have this situation:

A student in, say Geography, may be:

The PhD$_4$

- **in the Department of Human Geography,**
- **in the Division of Society and Environment,**
- **in the Research School of Pacific Studies,**
- **in the Institute of Advanced Studies,**
- **in the Graduate Program in Geographical Sciences,**
- **in the Graduate School.**

The student may also have registered an affiliation with two other programs. ... There is no clear hierarchy. Different decisions are made at different points…. Five levels are involved in the allocation of scholarships. Examiners are nominated at one level and approved at a multitude. The discipline seems to be represented at two points. … (Nelson, 1993, p. 9)



Message for the Graduate School?

Sweden: University Education

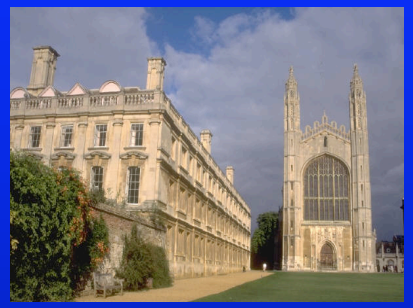
Sweden: long university tradition

- **e.g. Uppsala in 1477; Lund 1666**

Early years were "turbulent":

Uppsala **"The University fell into decay in the first decade of the 16th century due to the political unrest of the period."**

Lund **"The faculty's mixture of nationalities, comprising mainly Danes and Germans, and the shaky financial situation led to constant wrangling."** Closed between 1676–79



The PhD_3-Sweden

- **German & American PhD program influence**
- **4 year programs –coursework & thesis**
  (*Graduate School 5 years*)
- **Proliferation of programs**
- **Now: various graduate schools in Sweden (research structures; regulated supervision; structured program; multi / interdisciplinary cooperation, national & international networks)**
- **2001 – Starting Date for Graduate School in Mathematics Education**

Also see Leder GC, Brandell G & Grevholm B (2004)

Envisioning the Future of Doctoral Education C M Golde & G E Walker (Eds) (2006) (USA)

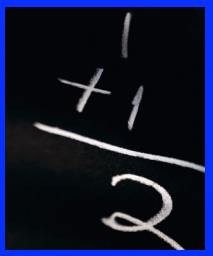
The program (Education)

Formal & Practical knowledge

- **Have substantive knowledge of the field**
- **Think theoretically and critically**
- **Frame fruitful research problems**
- **See research as socially situated**
- **Design research**
- **Collect & analyze data**
- **Communicate with various audiences about research**

The Program (Mathematics)

(USA)



- **Mastery of core foundational knowledge**
- **Specialized knowledge for original research**
- **Documentation & communication skills**

Changing employment markets for math PhDs:

1. **Research in the discipline**
2. **Applied research (i) in industry (ii) in government?**
3. **Teaching …**

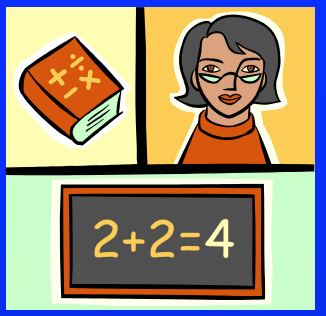
Use mathematics in different human activities

Other issues - mathematics

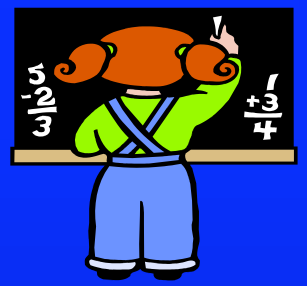
- Need increased diversity of candidates
- Teaching – various levels?
- Provide moral and financial support for doctoral & post doctoral fellows
- Shift from individual to team approaches
- Add to an already long doctoral program (e.g., pedagogy, industry internship, interdisciplinary studies...)

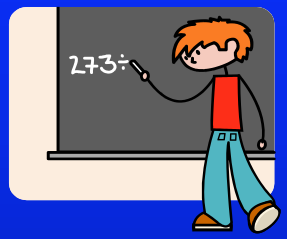
A guide to *Doctoral Programs in Mathematics Education* NCTM, 2002 (1)

- **Mathematics content – broad & deep**
- **Research – conceptualize & conduct→ advance understanding of mathematics learning & teaching**
- **Educational contexts – historical, social, political, psychological, economical, …**
- **Learning – theories of learning, robust theoretical constructs**
- **Teaching & Teacher Education – including clinical expertise, professional development programs, …**



A guide to *Doctoral Programs in Mathematics Education* NCTM, 2002 (2)





- **Technology** – as user & as agent of curriculum change
- **Curriculum & Assessment** – analysis, design, evaluation, …
- **Need**: critical mass of faculty with relevant expertise, supportive environment (people & physical), research opportunities, field work experience, proposal writing, publication preparation, …

The Swedish Graduate School in mathematics

Course work:

mathematics, didactics of mathematics, research methodology, …

Mix of regular mathematics PhD courses & special graduate school courses

Research & thesis in didactics of mathematics

TOPICS *include* **Limits of functions; aspects of textbooks (teaching, reading); preservice teachers' views of the concept of functions; aspects of proof; assessing mathematical creativity; aspects of probability – *lower secondary school*; history of mathematics**

Double competence: mathematics & education

Tension: depth v breadth

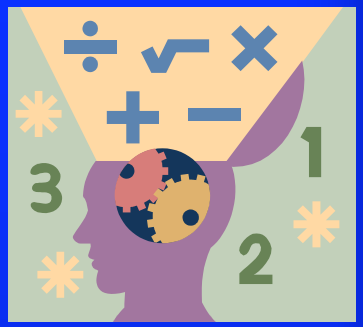
Licentiate topics Skovsmose (2006)

Key components – consistency between

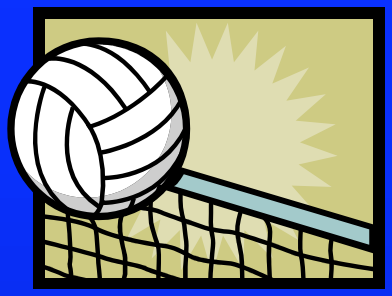
1. **Research questions**
2. **Data**
3. **Theoretical framework**
4. **Methodological approach**

Licentiate theses: "convincing degree of consistency between the … research questions, the collection/production of data, the theoretical clarification, and the methodological approaches".

Missing: explicit discussion of the link between theoretical perspectives and methodological approaches



The verdict 2006-2007 …



A guide to **Doctoral** Programs – *Graduate School report card* 1

- **Mathematics** content – broad & deepα
- **Research – conceptualize** & conduct→ advance understanding of mathematics learning & teachingα

Educational contexts – historicalα, social(α), political, psychological α, economical, …

- **Learning** – theories of learning α, robust theoretical constructs
- **Teaching & Teacher Education** α– including clinical expertise, professional development programs, …
- **Technology** – as user & as agent of curriculum change
- **Curriculum & Assessment** α– analysis, design, evaluation, …
- **Need**: critical mass of faculty with relevant expertise, supportive environment α

Completions

Graduate School Report card 2

First intake: 20 students September 2001

Length of candidature = 5 years ***(4 years+20%)***

OPTIMUM CONDITIONS

10 students [50%] completed by end 2006 (4 June 2006 + 2 mid Sept 2006 + 4 before end 2006)

(source *Bergsten personal communication Aug 22*)

LTU data: ~50% completed within 4 years; 80% within 5 years

Note: *only some students on scholarships with stipend; some students P/T*

The future?

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