Eliciting CS Teachers' PCK using the Content Representation Format

Experiences and Future Directions

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Pedagogical Content Knowledge

- "the knowledge of teachers to help others learn"

Lee Shulman

- strong PCK ~ good teaching ~ good learning outcomes
- PCK is personal, content-specific, often tacit

Components of PCK (after Magnusson et al., 1999)

what and why

possibilities and limitations

instructional strategies

assessment

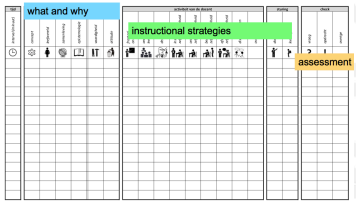
Elicitation of PCK

what and why

possibilities and limitations

instructional strategies

assessment



- interviews
  Henze, Van Driel, & Verloop 2008
- PaP-eRs
  Loughran et al. 2004
- reflective journals
  Wongsopawiro 2012
- classroom observations
  Gess-Newsome et al. 2011, Barendsen & Henze 2012
- content representation
  Loughran et al. 2004

Content Representation

John Loughran

What are the important ideas/concepts concerning this topic?

1. What do you intend the students to learn about this Big Idea?
2. Why is it important for the students to know this Big Idea?
3. What else do you know about this Big Idea (and you don't intend students to know yet)?
4. What are the difficulties/limitations connected with the teaching of this Big Idea?
5. Which knowledge about students' thinking influences your teaching of this Big Idea?
6. Which other factors influence your teaching of this Big Idea?
7. What are your teaching methods (any particular reasons for using these to engage with this Big Idea)?
8. What are your specific ways of assessing students' understanding or confusion around this Big Idea?

Content Representation (CoRe)

From:: Loughran, J., Berry, A., & Mulhall, P. (2006). *Understanding and Developing Science Teachers' Pedagogical Content Knowledge*. Rotterdam: SensePublishers.

	important ideas/concepts			
	Big Idea A	Big Idea B	Big Idea C	Big Idea D
1. What do you intend the students to learn about this Big Idea?	what and why			
2. Why is it important for the students to know this Big Idea?				
3. What else do you know about this Big Idea (and you don't intend students to know yet)?				
4. What are the difficulties/ limitations connected with the teaching of this Big Idea?	possibilities and limitations			
5. Which knowledge about students' thinking influences your teaching of this Big Idea?				
6. Which other factors influence your teaching of this Big Idea?	teaching strategies			
7. What are your teaching methods (any particular reasons for using these to engage with this Big Idea)?				
8. What are your specific ways of assessing students' understanding or confusion around this Big Idea?	assessment			

Variation I: Focus Groups on Programming

- Mara Saeli (2012)
- goal: portray 'shared' PCK
- 6 groups in Lithuania, Italy, Belgium, The Netherlands

- sessions of 2 hours each
- 2 or 3 'big ideas'
  control structures, data structures, arrays, problem solving, decompositon, parameters, algorithms
- filling in CoRe form individually, then group discussion

- analysis of forms and audio/video recordings

- similar setting: teacher retraining in Nijmegen, NL

Variation II: Electronic collection of PCK data

- Saeli, Perrenet, Jochems, & Zwaneveld (2012)
- online questionnaire
- 92 teachers, 69 valid responses
- CoRe questions on a concept (respondent's choice)
- CK questions

- articulated PCK poor wrt extracurricular knowledge, instructional methods
- richer wrt reasons, students' prior knowledge and difficulties

Variation III: Monitoring individual development

- Buchholz, Saeli, & Schulte (2013)
- pre-service teacher education

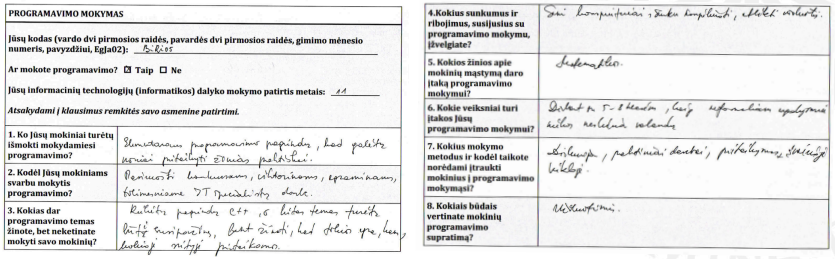
- students fill in CoRe forms:
  before and after first teaching,
  again after a few iterations
- results of group discussions are represented on a CoRe form

- teaching nexus: questions 1, 2, 3
- learning nexus: questions 4, 5, 8

- teacher-centered focus clearly visible

Variation IV: Individual Forms on Programming

- workshop for CS and IT teachers in Lithuania
- CoRe on "programming"
- on paper, 30 minutes



PROGRAMAVIMO MOKYMAS	
Jūsų kodas (vardo dvi pirmosios raidės, pavardės dvi pirmosios raidės, gimimo mėnesio numeris, pavyzdžiui, Egla02): Bi1102	
Ar mokote programavimo? ☒ Taip ☐ Ne	
Jūsų informacinių technologijų (informatikos) dalyko mokymo patirtis metais: 11	
Atsakydami į klausimus remkitės savo asmenine patirtimi.	
1. Ko Jūsų mokiniai turėtų išmokti mokydamiesi programavimo?	Skaitomas programavimo pagrindas, bet galėtų siekiai pritaikyti žinias praktikai.
2. Kodėl Jūsų mokiniams svarbu mokytis programavimo?	Reikės kūrimas, vibrinimas, egzaminavimas, tobulinimas IT specialisto darbe.
3. Kokias dar programavimo temas žinote, bet neketinate mokyti savo mokinių?	Rašytis pagrindas C++, o kitos temos funkcijos. Būtų įvairiaštis, bet žinoti, bet dėlei yra, kam, kokiuose mėgėjų pritaikoma.
4. Kokius sunkumus ir ribojimus, susijusius su programavimo mokymu, įžvelgiate?	Sai kompiuteriai, šiuo kompilatoriai, skirtingi versijos.
5. Kokios žinios apie mokinių mąstymą daro įtaką programavimo mokymui?	Sudėtingos.
6. Kokie veiksniai turi įtakos Jūsų programavimo mokymui?	Darbas po 5-8 klasės, kuris reikalauja nuolatinio susipažinimo kitos versijos valandos
7. Kokius mokymo metodus ir kodėl taikote norėdami įtraukti mokinius į programavimo mokymąsi?	Diskusija, praktiniai darbai, pritaikymas, skatinantys kitiems.
8. Kokiais būdais vertinate mokinių programavimo supratimą?	Užduotimis.

Analysis

- 34 forms
- this study: questions 1 and 2

- inductive qualitative analysis, coding scheme
- re-coding
- frequency analysis

- grouping:
  - A: experience < 10 years
  - B: experience 10-14 years
  - C: experience 15-19 years
  - D: experience > 20 years

- explore patterns within groups, differences between groups
- further (in-depth) review of the answers

Findings

Question 1: what?

- experienced teachers stress higher-order skills
- beginning teachers focus more on simple applications
- especially experienced teachers mention attitudes
- answers of experienced teachers show more skills and greater variety
- not many program concepts visible, plenty of process issues

Findings

Question 2: Why?

- many teachers stress role of programming in developing thinking skills
- logical thinking:
  - prerequisite or learning goal according to beginning teachers
  - result of learning to program for according to experienced teachers
- many references to future (professional) activities, mostly in IT

Discussion

- differences seem to reflect respective backgrounds of teachers
- worthwhile exploring further
- various opinions correspond to positions in scientific community
- data is surprisingly rich
- what have we measured? PCK? curricular beliefs?

General comparison

aspect	*Focus groups*	*Electronic*	*Teacher Education*	*Lithuanian case study*
data	group	individual	individual and group	individual
scope	given topic (programming) with participants defining Big ideas	given topic and given Big idea (loop within programming	given topic without big ideas (programming)	
medium	verbal and written	written (electronic)	verbal and written	written (pen & paper)
context	reflection in context of a topic/big idea	reflection in context of a topic/big idea	reflection with focus on one specific teaching experience	reflection in context of a topic/big idea
time	1-2 hours	individual	15 min to 60 min	15-30 min
intention	individual diagnostics & reflection on practice with peer discussion	research, characterizing PCK	individual diagnostics & reflection on practice with peer discussion	research, characterizing PCK