HALMSTAD UNIVERSITY

Developing student teachers' PCK for teaching technology with a sustainability edge in primary school

Anne-Marie Cederqvist & Per Högström

Liverpool John Moores University, 31 October to 3 November 2023

Introduction

- Technology education - important for developing pupils' understanding of technology in everyday life
- This involves making pupils aware of sustainability issues in relation to technology
- Technology education in primary school may look very different depending on what classroom pupils enter
- Many teachers are uncertain about what technological knowledge the content in the curriculum represents and what approaches characterize the subject
- Teachers feel unprepared when it comes to teaching about sustainable development (SD)

- As teacher educators we need to provide student teachers with both theoretical and practical knowledge of technology and help them transform it into Pedagogical Content Knowledge (PCK) for teaching technology. Further, education for sustainability needs to be integrated more explicitly

Aim of the study

To address these issues we have jointly generated a collaboration between teacher educators and KomTek - a municipal technology school that offers in-service teachers practical technology activities

- The aim of the study is to capture and understand how student teachers transform acquired knowledge and skills into Pedagogical Content Knowledge (PCK) with special attention to sustainable development

Pedagogical Content Knowledge (PCK)

PCK: the way of understanding the complex relationship between pedagogy and content through an integrated process rooted in classroom practice

Shulman (1987) suggests that developing PCK involves a considerable shift in teachers' (and student teachers') understanding from:

"*being able to comprehend subject matter for themselves, to becoming able to elucidate subject matter in new ways, reorganize and partition it, clothe it in activities and emotions, in metaphors and exercises, and in examples and demonstrations, so that it can be grasped by students.* (p. 13)

Design-Based Implementation Research

DBIR - to create the conditions for studying processes that occur when stakeholders at different levels interact with a relatively clear objective of what to implement (Fishman & Penuel, 2018).

The process includes identifying design principles (DPs) that support the identification of outcomes through the course of a study. Our identified DPs are informed by technology education and ESD literature:

Design Principles:

- DP1: Basing the study within DBIR as a methodology (Fishman & Penuel, 2018)
- DP2: Supporting the establishment of iterative cooperation between stakeholders (Fishman & Penuel, 2018)
- DP3: Incorporating interior dimensions and personal values as a guide for pedagogical considerations about SD (Holbrook, 2009; Pavlova, 2013; Wamsler et al., 2021)
- DP4: Supporting transformed learning opportunities informed by PCK (Carlson et al. 2019)
- DP5: Integrating conceptual and procedural knowledge within the teaching activities (Norström, 2014; Pavlova, 2013)

HALMSTAD UNIVERSITY

The Teaching Module Design

Block	Content	Activities
Block 1 Theoretical Session 1–4[a]	Epistemology of technology History of technology Design and technological documentation Construction techniques, strength and durability theory, and materials	Literature seminars Group work Workshops
Block 2 Practical Session 5–8[b]	KomTek: Mechanics and Digital Models Everyday mechanics Programming	Practical technology workshops
Block 3 Theoretical Session 9[c]	Technology, human, society, and technological systems	Discussion seminars on SD, safety, ethical considerations Workshop with a debate on SD/technology, and discussions on ethical dilemmas
Block 4 Synthesising Session 10–12	Plan and teaching technology	Planning lesson: Mechanics TinkerCad Programming Electronics Lesson plan revision[d]. Perform lesson with pupils[e].

HALMSTAD UNIVERSITY

Note: a = 180 min each; b = 180 minutes each; c = 180 min; d = 180 min each; e = 240 min for each group, 90 min lesson with pupils.

Method

- The Educational Context and participants
  - A course module within a Science and Technology course of 30 credits
  - 12 Student teachers enrolled in the course are preparing to become teachers in primary school, grades 4–6

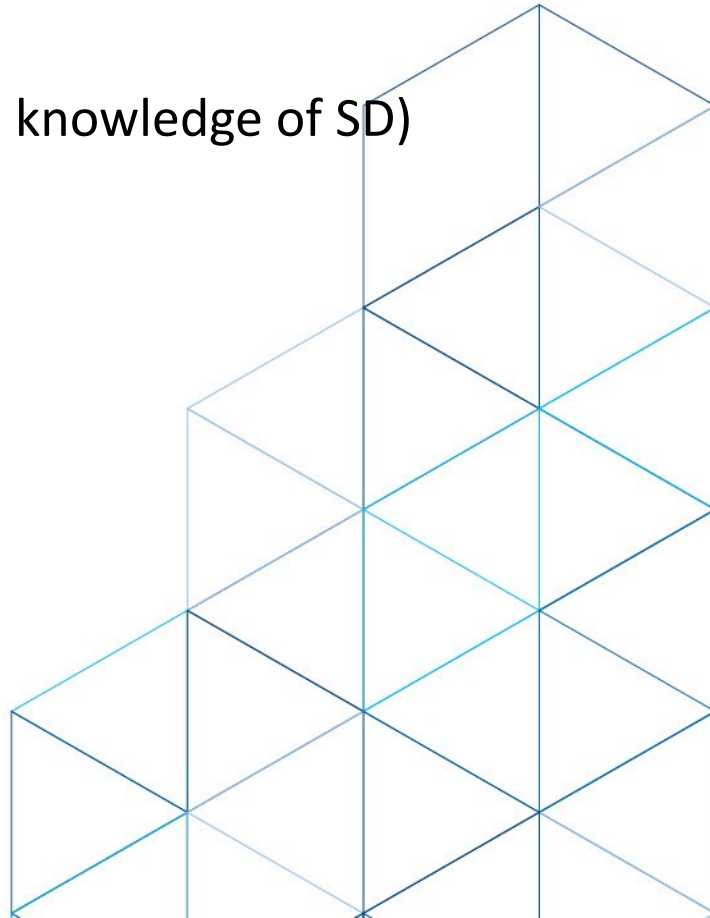
- Data collection
  - Student teachers' individual written reflections on technology education and SD (before and after)
  - Student teachers' lesson plans
  - Semi-structured interviews after performed lessons
  - Individual project assignments

Analysis

Content Analysis

- Coding using five PCK components derived from the research literature (Carlsson et al., 2019; Magnusson et al., 1999):
  - Knowledge of content (conceptual knowledge, procedural knowledge, knowledge of SD)
  - Knowledge of curriculum
  - Knowledge of instructional strategies
  - Knowledge of students
  - Knowledge of assessment

- Coding for inner qualities and capacities for transformation
  - e.g., empathy, courage, relating, cooperating, critical thinking



HALMSTAD UNIVERSITY

Results

Transformative accounts of the development of PCK – one example

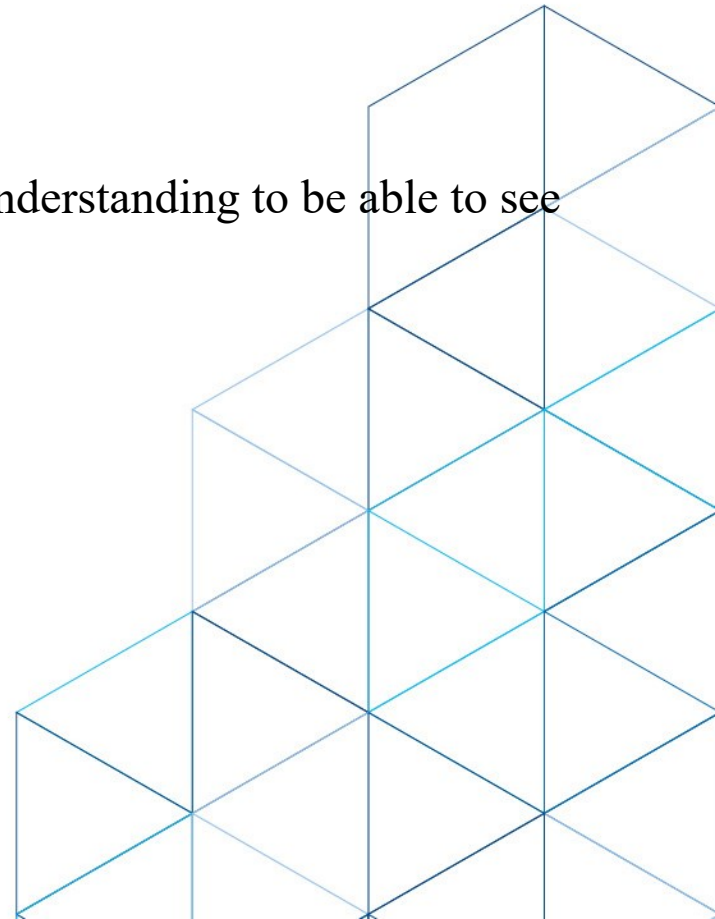
The need for knowledge is addressed initially

[…] You must have a good understanding of technology development concerning SD

[…] You should also consider the pupils you meet by observing their interests and pre-understanding to be able to see what they need to develop […]

PCK components

knowledge of content, knowledge of instructional strategies, knowledge of students



HALMSTAD UNIVERSITY

Results

Transformative accounts of the development of PCK – one example

A student teacher reflects on her planned technology lessons

"The task invites discussions and reflection regarding the choice of materials, waste, and the structure of the construction with a focus on stability and durability as constructing with 3D printers makes it possible to influence these points. […] the pupils also need to develop knowledge of documentation such as sketches and digital models [...] During the work, the teacher invites to discussions about the material, structure, strength of the pieces, and the pros and cons of the production method concerning SD. […] Assessment will be made on pupils' reports and documentation in the form of sketches, digital models in TinkerCad, and finished products. All parts are assessed according to the grading criteria for the technology curriculum."

(From the individual project assignment)

PCK components

knowledge of content (conceptual and procedural), knowledge of instructional strategies, knowledge of curriculum and ***knowledge of assessment***

HALMSTAD UNIVERSITY

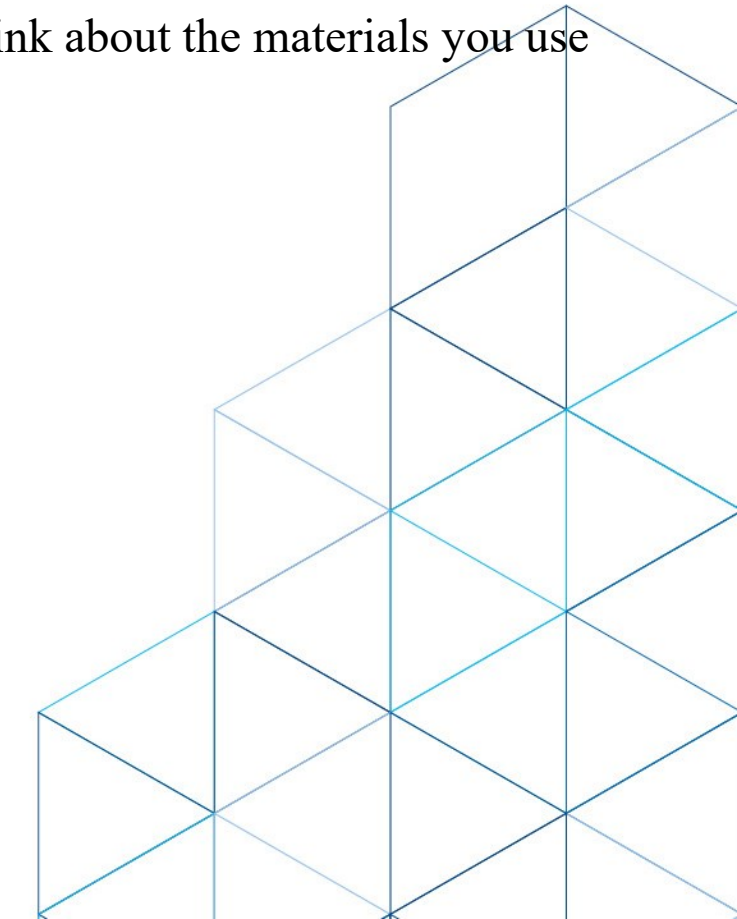
Results

Sustainable development (SD) is connected to technology education

[…] I don't remember that we have encountered something like this where you must think about the materials you use or how to construct things, or think sustainable, it was new for me.

[...] now it just feels obvious that it should be fitted together.

knowledge of content, knowledge of instructional strategies



HALMSTAD UNIVERSITY

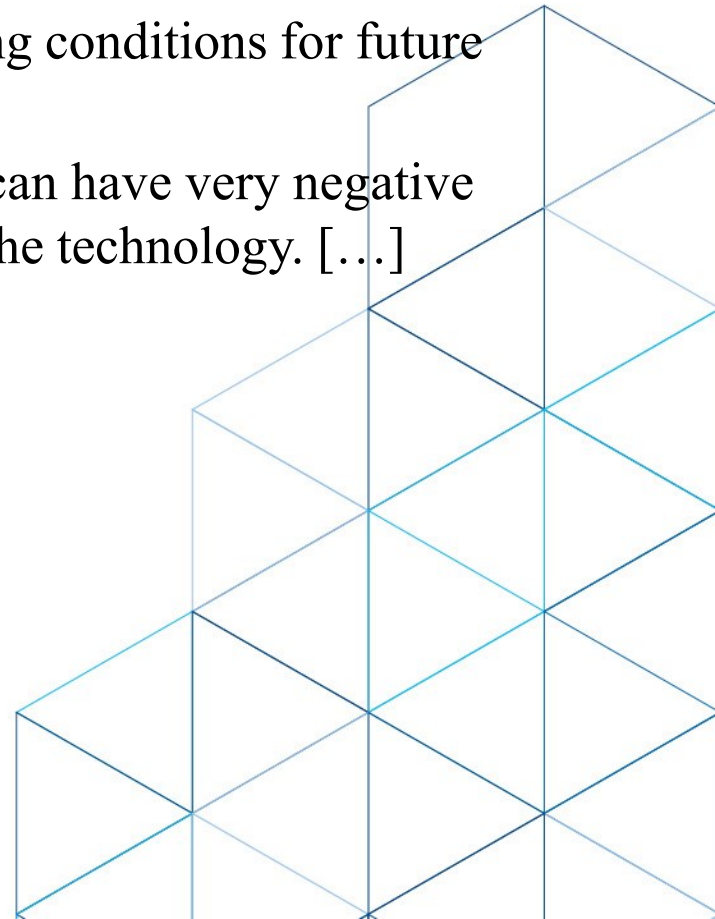
Results

Personal values and inner qualities

[…] SD implies using and developing technology without jeopardizing the living conditions for future generations.

[…] I believe that the two concepts should always be connected as technology can have very negative consequences if we do not have SD in mind when we create, use, and develop the technology. […]

Empathy, Relating, Critical thinking



HALMSTAD UNIVERSITY

Discussion

The results indicate two design principles in the first iteration of the teaching module that needs further attention:

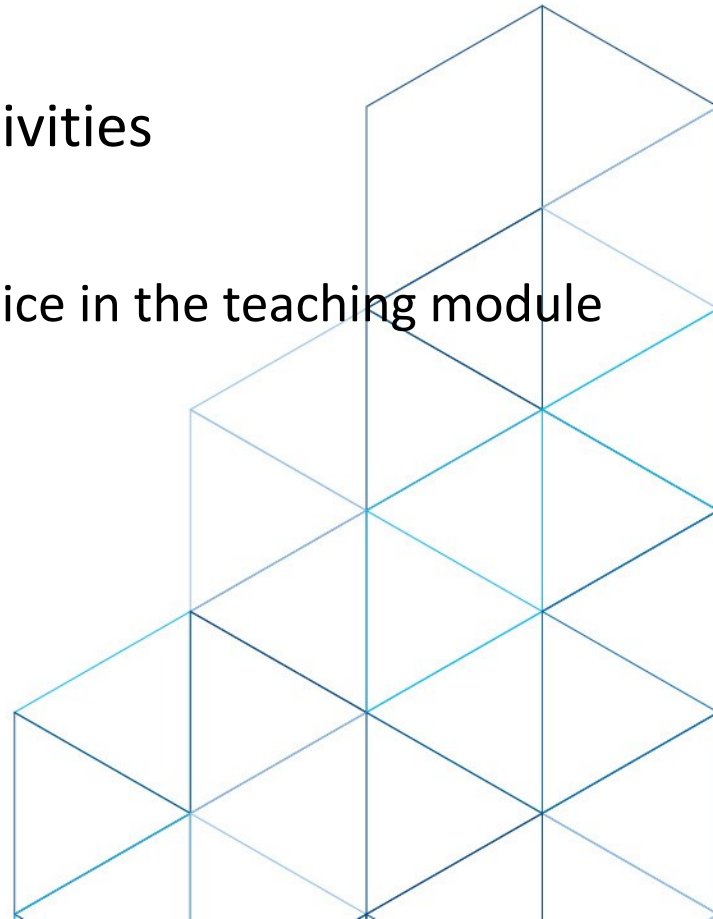
- DP3: to incorporate personal values of SD as a guide for pedagogical considerations about SD
  - there are still difficulties in integrating activities that may help student teachers promote the pupils' understanding.
  - inner qualities and capacities need additional attention to help the students address interior dimensions, which is crucial for the development of individual agency.

Discussion

The results indicate two design principles in the first iteration of the teaching module that needs further attention:

Incoherence between the content presented and the practical activities

- DP5, to integrate conceptual and procedural knowledge.
  - The re-design implies that synthesising, hence integrating, appears twice in the teaching module



HALMSTAD UNIVERSITY

The re-designed teaching module

Block	Content	Activities (on schedule)	Activities (off schedule)
Block 1 Theoretical Session 1-5[a], and Inner Qualities Session 1-4[b]	Epistemology of technology History of technology Design and technological documentation Construction techniques, strength and durability theory, and materials Technology, human, society, and technological systems	Literature seminars Group work Workshops Discussion seminars on SD, safety, ethical considerations Workshop with a debate on SD/technology, and discussions on ethical dilemmas	Inner Qualities Lectures: Presence and Learning Mindset Reflective listening Sense-making Complexity awareness Inner Qualities labs: Meditation Mirroring Conscious story of life Sense of purpose
Block 2 Synthesising Session 6[c]	Introduction to planning and teaching technology	Planning lesson: Mechanics TinkerCad Programming Electronics	
Block 3 Practical Session 7-9[d]	KomTek: Mechanics and Digital Models Everyday mechanics Programming	Practical technology workshops with theoretical base from Block 1	
Block 4 Synthesising Session 10-11	Plan and teach technology	Lesson plan revision[e]. Perform lesson with pupils[f].	

DP5 → Synthesising appears twice

DP3 → We choose to introduce lectures and inner qualities labs as off-schedule opportunities

Note: a = 180 min each; b = lectures, 15 min each, labs, 30 min each; c = 180 min; d = 180 min each; e = 180 min each; f = 240 min for each group, 90 min lesson with pupils

HALMSTAD UNIVERSITY

Thank you/references?

anne-marie.cederqvist@hh.se

per.hogstrom@hh.se