Education for Sustainable Development through Socioscientific Issues

Education for Sustainable Development through Socioscientific Issues: Pre-service Teachers' Pedagogical Design Capacity

Tuba Stouthart, Dury Bayram, Jan van der Veen

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Research Team

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Education for Sustainable Development (ESD)

Pedagogical Design Capacity (PDC)

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Socioscientific Issues (SSI)
Education for Sustainable Development (ESD)

Pedagogical Design Capacity (PDC)
Pre-service teachers (PSTs)

SCIENCE EDUCATION
for the REST OF US

We need to empower teachers with necessary pedagogical design capacity

Socioscientific Issues

- Complex

- Controversial

- Provide a context for understanding science

- Require scientific knowledge

- Require the use of evidence-based reasoning

- Require a degree of moral reasoning

Sadler & Zeidler (2004)

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Education for Sustainable Development (ESD)

- knowledge, skills, attitudes and values

- transition to sustainable lifestyles

- integrating key sustainable development issues into teaching

- far-reaching changes to the way education is practiced

SUSTAINABLE DEVELOPMENT GOALS

(UNESCO, 2013, 2017, 2020)

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Pedagogical Design Capacity (PDC)

"*ability to perceive and mobilize existing resources in order to craft instructional contexts*"
(Brown, 2019, p. 24)
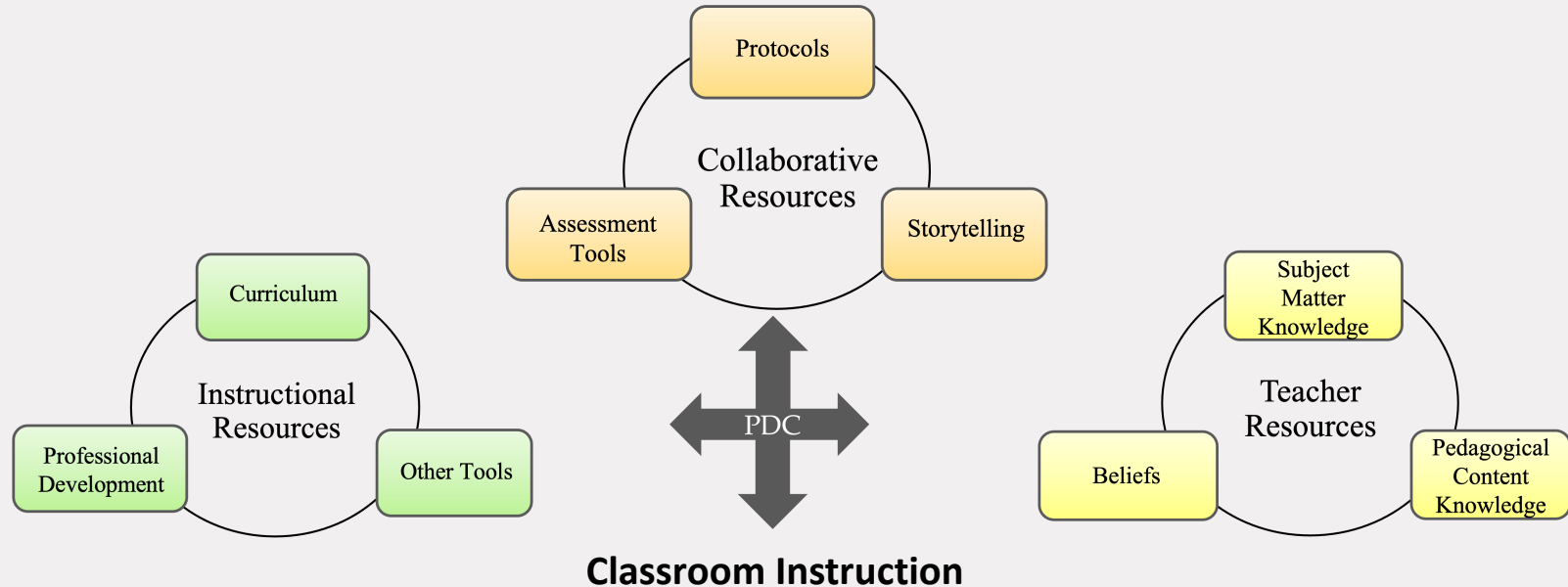
(Brown, 2009; Ellingson, 2018; Knight-Bardsley & McNeill, 2016)

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Research Questions

1) How can STEM pre-service teachers' pedagogical design capacity for designing SSI-based lessons to teach about the sustainable development goals be characterized?

2) How does the use of the different types of resources impact PSTs' lesson design for teaching about the sustainable development goals through SSI in Dutch secondary education?

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Qualitative Research Design

Participants

5 pre-service STEM teachers (PSTs) formed a professional learning community (PLC) together with 2 researchers as the facilitators of the PLC meetings

PLC Meetings

Over the course of five months, there were 6 PLC meetings, each lasted approximately two hours

Data Collection

- field notes from the PLC meetings,
- reflection reports by the PSTs,
- semi-structed interviews with two volunteer PSTs

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Professional Learning Community (PLC)

Participants

Participant	Subject
PST 1	Computers
PST 2	Physics
PST 3	Physics
PST 4	Mathematics
PST 5	Mathematics

PLC Meetings

Meeting	Description
Oct '22	What SSI are, their relevance for teaching about the SDGs. Two in-service teachers (Biology and Physics) joined this meeting and shared their experiences with SSI and ESD
Nov '22	PTSs discussed their findings in the literature related to SSI. Comparison between SSI with other …–based teachings
Dec '22	PSTs chose two focus points for their design: **teachers' role in SSI**, and **students' motivation** to learn about the SDGs
Jan '23	PSTs continued with the two aspects in their design: teacher's role and motivation
Jan '23	PSTs focused on the documentation of their work, and on creating a poster to present their work to their peers
Feb '23	Reflection on the PLC meetings and feedback

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Data Analysis and Results

PDC Resource Categories	Codes	Frequency (*f*)
Instructional Resources	Professional Development (PD) Sessions	
	Curriculum	
	Other Tools	
	SSI*	176
	Literature*	
	Birdging the Curriculum*	
	Lack of Tools/Support*	
Collaborative Resources	Protocols	
	Storytelling	
	Assessment Tools	178
	Finding Common Ground*	
	Giving and Receiving Feedback*	
	Consulting with Experts*	
Teacher Resources	Beliefs	
	Subject-matter Knowledge	
	PCK-Goals and Objectives (PCK-GO)	
	PCK-Instructional Strategies (PCK-IS)	293
	PCK-Students' Understanding (PCK-SU)	
	PCK-Assessment (PCK-AS)	
	Previous Experiences*	

*Codes that were added throughout the axial and selective coding.

Pedagogical Design Capacity (PDC)

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Results: Instructional Resources

Instructional Resources

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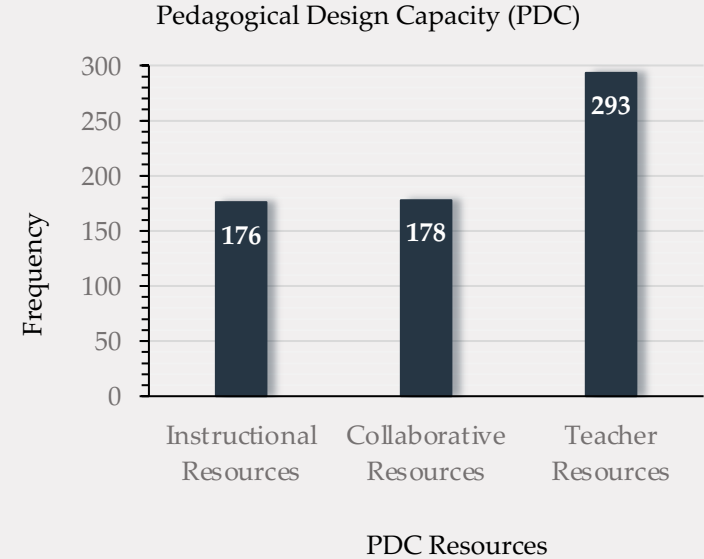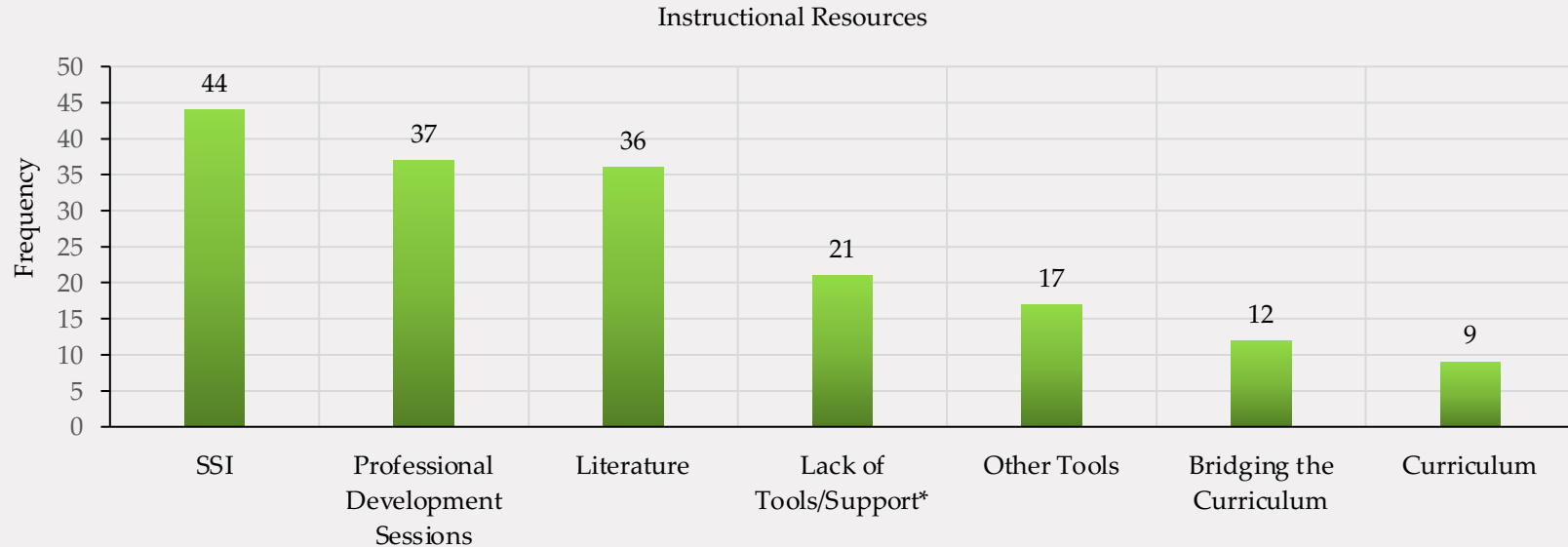
Results: Instructional Resources

*If you are like me, and you think of sustainability, you think of creating energy and energy transition. But, well, the SDGs showed that it is much bigger than that and **we think SSI would be very effective** because you can really apply them in very much more. You can use SSI in Physics, but you can also apply it in Geography or History. This allows you to use it in a lot of different courses in secondary schools.*
(field notes, PST 3)

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Results: Instructional Resources

> *I have never done a literature review before. I used Google but **it is difficult to filter out**. When you write SSI, a lot of sources appear. The challenge is how to filter out good articles and then how to filter **good information** from those articles. (field notes, PST 4)*

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Results: Collaborative Resources

Collaborative Resources

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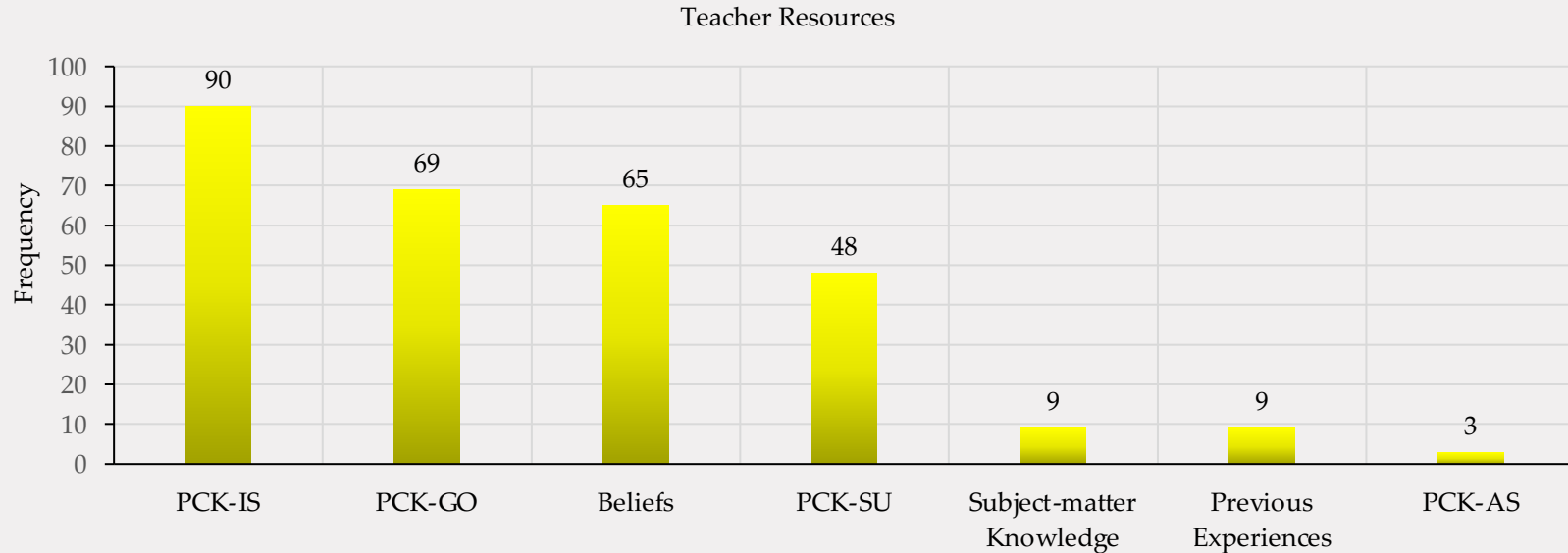
Results: Collaborative Resources

> *Now we can define **some tasks**, but we are not there yet. Maybe we should do like **action points** to go through, that we can work at. Now I think we should focus on Spider Web [a tool provided to PSTs to help them with their design] and make **some definitions**. That will make it more concrete for sure.*
> *(field notes, PST 1)*

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Results: Teacher Resources

Teacher Resources

PCK-Goals and Objectives (PCK-GO)
PCK-Students' Understanding (PCK-SU)

PCK-Instructional Strategies (PCK-IS)
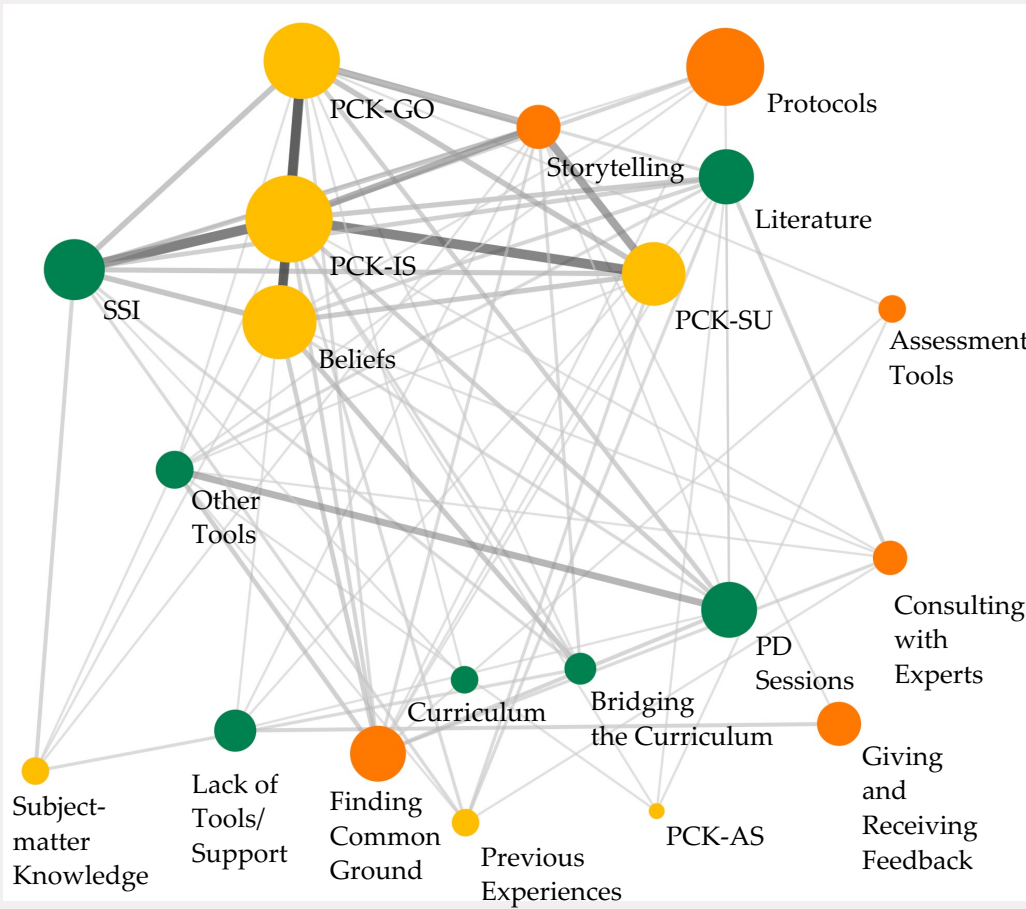PCK-Assessment (PCK-AS)

Results: Teacher Resources

> *It is a fine line because of course **you can not give in to students' demands entirely**. You can train them in doing so. For example, I took Research and Design [a secondary school subject in the Dutch education system] for six years and at the start **we were not really spoon-fed, but it was close to it**. In the end we were like, in my sixth year of secondary school, running a project by ourselves. (...) We defined our own assignment, and our teacher was **more watching on the side-lines**. In the first years, the teacher would find the company and the assignment. (PST 3, interview)*

PCK-Goals and Objectives (PCK-GO)
PCK-Students' Understanding (PCK-SU)

PCK-Instructional Strategies (PCK-IS)
PCK-Assessment (PCK-AS)

Results

- Unlike 'PCK-assessment', the three PCK-related sources played an important role in PSTs' design.

- Compared to other *collaborative resources*, 'storytelling' is strongly connected with PCK-related resources.

PCK-Goals and Objectives (PCK-GO)
PCK-Students' Understanding (PCK-SU)

PCK-Instructional Strategies (PCK-IS)
PCK-Assessment (PCK-AS)

Discussion

- The use of SSI is promising to facilitate ESD (Ariza et al., 2021; Harskamp et al., 2021)

- STEM PSTs' decisions regarding their design relied on more than just *instructional resources* and *teacher resources*; they also referred to each other as *collaborative resources* (Ellingson, 2018)

- Considering all the available resources, PSTs used their 'PCK-Assessment' the least. This suggests that there is a lack of assessment (Evagorou & Dillon, 2020) and of assessment methods (Bayram-Jacobs et al., 2019) in SSI-based instruction.

- PSTs need support when it comes to assessment in ESD and sustainability-related competences (Rieckmann, 2022)

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Conclusion/implications

- More opportunities to design SSI lessons to address the SDGs

- Curriculum designers should accommodate the adaptation of instructional materials

- Collaboration among teachers, interdisciplinarity in STEM lesson designs

- Emphasis on assessments when it comes to SSI and ESD, both formative and summative assessment methods

- Equip PSTs with sustainability-related competences

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Contact Information

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Thank you!

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