

Developing Teachers' Topic-specific Pedagogical Content Knowledge (PCK) in Secondary Physics

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KEY IMPLICATIONS

- This project provided an opportunity for translating some of the relevant new findings in the literature of pedagogical content knowledge (PCK) (Shulman, 2015) into practice in our professional development (PD) exploration and collaboration with the schools.
- The 3-stage PD approach provided some practical insights on the PCK elements of knowledge, practices and beliefs of physics teachers in the teaching of the topics of electricity and energy.
- The knowledge gained from the project will be useful for informing Physics Heads/Teacher Leaders, Science Department Heads and School Leaders in the implementation of a viable PD approach in developing the PCK of our physics teachers.

BACKGROUND

As teacher leaders helping the physics chapter of the Academy of Singapore Teachers, it is a key part of our team's work to deepen the PCK of our physics teachers, build a culture of teacher-led professionalism and pride in the fraternity, and foster professional collaboration and networked learning among its members.

In alignment with the academy's strategy of providing quality PD in curriculum, assessment and pedagogy, this project engaged physics teachers in a study on the development of their professional knowledge and classroom practices through a collaborative PD approach. Its focus on capturing, portraying and sharing

the teachers' PCK to empower physics teachers in providing quality student learning will also help extend the current notion of what is good physics teaching to the physics teaching fraternity.

FOCUS OF STUDY

The aim of this project was to explore the use of a school-based PD approach to enhance the PCK of secondary physics teachers in the teaching of specific physics topics.

A consolidated model of PCK (Gess-Newsome, 2015) that emerged from a seminar in 2015 by a team of leading researchers on PCK provided greater clarity and the opportunity for our team to explore our understanding of PCK with this project. The updated PCK model which defined PCK as both the knowledge base as well as the enactment of the teacher allowed us to examine the planning, enactment and reflection stages of PD of physics teachers from different schools as they prepared, conducted and reviewed their lessons and experiences for the respective topics taught.

The collaboration of the researchers and the respective schools' team of physics teachers enabled both groups to gain a better understanding of the collective and individual teachers' knowledge, beliefs and practices related to the topics covered. Teaching resources and reflection documents developed and/or used for the specific topics from the study will be shared with the physics teaching fraternity at suitable platforms.

KEY FINDINGS

From the insights gained in the two case studies, the following assertions were made on the factors and considerations necessary to enhance the development of topic-specific PCK of teachers when adopting the proposed 3-stage PD approach:

- The professional learning team (PLT) will need to use the Content Representation (CoRe) (Loughran, Berry, & Mulhall, 2012) tool in the planning and reflection stages of the 3-stage PD approach to examine at a deeper level the key ideas in the topic that students need to learn and how to learn them meaningfully.
- The 3-stage PD approach requires a spirit of exploration and innovation by the PLT for impactful learning experiences to be generated for the students.
- In using the 3-stage PD approach, the PLT need to encourage among its members the higher aim of helping their students see that they are learning to succeed in life rather than for passing exams.
- The PLT is a crucial platform for the significant development of the topic-specific PCK of teachers of a discipline in a school.
- The 3-stage PD approach requires active participation and an openness to learn from the perspectives and feedback of fellow members in the PLT.

SIGNIFICANCE OF FINDINGS

This project has provided insights on how a school-based 3-stage PD approach can be an effective alternative to the conventional PD workshops and courses for the professional learning of our physics teachers. The successful involvement of two PLTs of teachers from two different schools in their collective planning, enacting and reflecting in the design of specific physics topics allowed for a fruitful collaboration and exploration of the PD approach. The knowledge gained will be useful for informing Physics Heads/Teacher Leaders, Science Department Heads and School Leaders in the implementation of a viable PD approach in developing the PCK of our physics teachers.

PARTICIPANTS

Two secondary schools identified through their physics teachers/teacher leaders' involvement in the physics chapter's professional learning programme agreed to participate as case studies for the project. The two teams of teachers, 4 and 2 in numbers, and their students of about 50 and 60 students respectively involved for the study represented varied profiles of participants that provided diversity and representation in the overall comparative analysis of the two case studies.

RESEARCH DESIGN

The multiple case study approach (Yin, 2003) was used to obtain insights into the processes of change observed in the teachers' knowledge, beliefs and practices in each of the two schools over two cycles of the PD approach. The iterative design-based model facilitated a closer study of the PD process under the framework of Shulman's pedagogical reasoning and action model. It allowed for the exploration of how the PD approach could be co-developed at two schools with differences in school environment, teaching culture and student learning profiles.

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