Evaluating in-service teachers pedagogical content knowledge for teaching physics

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Abstract. This study presents the results of an evaluation of a teacher professional learning summer school, designed to develop the in-service science/mathematics teachers pedagogical content knowledge (PCK) for teaching physics. Workshops were facilitated online on a range of topics, including active learning, catering for diverse learners, formative and summative assessment, making connections, digital technologies, and the use of research to inform practice. Findings from a thematic analysis of units of learning designed by teachers will be discussed and provide insights into the influence of this programme on in-service teachers PCK for teaching physics.

Introduction

One of the major challenges facing education systems internationally is the shortage of in-service teachers who are qualified to teach physics. In 2020, the Department of Education & Skills in Ireland set out to address the shortage of qualified physics teachers and out-of field physics teaching in Irish second level schools. ("Out-of-field" teaching refers to the practice of assigning second level teachers to teach subjects that do not match their training or education.) The Professional Diploma in Teaching Physics (PDITP) programme was established to upskill in-service science/mathematics teachers to meet subject accreditation requirements to teach physics at upper secondary level.

Recent reviews of science teacher professional development programmes emphasize the need for science content and teachers' active participation in following or experiencing model lessons, planning lessons, and enacting and reflecting on lessons, as well as sufficient duration and support from experts. Seven features for effective science teacher professional learning have been identified [1]: (1) it is content focused, (2) incorporates active learning utilizing adult learning theory, (3) supports collaboration, typically in job-embedded contexts, (4) uses models and modeling of effective practice, (5) provides coaching and expert support, (6) offers opportunities for feedback and reflection, and (7) is of sustained duration. Such an approach secures not only the academic aspects of teacher professional learning but also places a considerable emphasis on teacher active involvement in the process of education design, feedback and self-reflection, development of collaboration attitude and regular collaboration practice, as features of professional learning. The model takes into account support from external stakeholders and is perceived as "an essential component of a comprehensive system of teaching and learning that supports students to develop the knowledge, skills, and competencies they need to thrive in the 21st century" [1].

Research highlights the importance of providing opportunities for teachers to reflect on their current teaching practices, obtain experience of and analyses desired practices, try ready-made lesson plans, and plan new lessons following instructive examples [2]. In particular recent reviews highlight that supporting teachers to carry out a practitioner inquiry (PI) on their own

practice as part of a professional learning community (PLC) will enhance their content knowledge for teaching physics [3].

Methodology

The PDITP programme is delivered as a blended learning programme over a two-year period and teachers complete 15 ECTS of physics pedagogy alongside 60 ECTS of physics lecture and laboratory modules. The goals of the PDITP programme are that teachers: (1) Acquire the theoretical and experimental knowledge of physics as well as pedagogical content knowledge that is necessary for effective physics teaching at the second level; (2) Demonstrate an ability to connect physics content modules and the school physics curriculum; (3) Develop a high standard of practical competence in physics teaching as reflective practitioners. During a week-long online summer school at the end of year one, teachers are introduced a range of pedagogical topics, including active learning, catering for diverse learners, formative and summative assessment, making connections, digital technologies, and the use of research to inform practice. In the following weeks, teachers collaborate in small groups to design a unit of learning for teaching physics at lower or upper secondary level on a topic of their choosing. This study presents a thematic analysis of 55 in-service teacher's units of learning to examine what are these teachers pedagogical content knowledge for teaching physics?

Findings

This study presents the results of an evaluation of a teacher professional learning summer school involving 55 in-service science/mathematics teachers that were completing the PDITP upskilling physics programme in Ireland. This study will present the structure and design of the summer school and discuss strategies adopted for facilitating teacher learning, collaboration and reflection. Findings from a thematic analysis of units of learning designed by these teachers will be discussed and provide insights into the influence of this summer school on teachers PCK for teaching physics. Teachers' experiences and learnings from this summer school is embraced in the design of a second summer school that facilitates teachers to collaborate as a professional learning community (PLC) to carry out a practitioner inquiry (PI) on their own classroom practice.

References

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