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The Impact of a Learning Study on the Practice of Experienced Physical Sciences Teachers Topic-Specific PCK in Stoichiometry

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Abstract

The topic of stoichiometry, which deals with the quantitative aspects of chemical reactions, is considered difficult to teach. Students' poor performance in the topic is also well documented in the literature. In the South African context, students' poor performance in final exit examinations, particularly on the mole, have sparked concerns over the teaching and learning of the topic, which has, in turn, highlighted the need for professional development. This thesis reports on a study conducted to determine the potential of a Learning Study as a professional development activity to develop teachers' topic-specific pedagogical content knowledge in the mole. The study was conducted using a mixed methods research methodology in two distinct phases. In the first phase, the quality of experienced teachers' topic-specific PCK was determined using instruments to measure teachers' TSPCK and content knowledge. Responses to the instrument were used to determine the quality of teachers' teaching approaches when teaching stoichiometry. This phase of the study highlighted that most teachers teach stoichiometry algorithmically. These results were used to inform the second phase of the study, particularly the focus of the professional development activity. During the second phase of the study, a Professional Learning Community was formed with three teachers selected from those who had completed the instruments in the first phase of the study. These teachers were enrolled in a post-graduate program, with the Professional Learning Community forming part of their own research component. Together with their supervisors as experts, we planned a lesson on the mole, explicitly using the construct of TSPCK in a Learning Study. During the Learning Study, the lesson was critically discussed and improved on over three cycles. These discussions formed the basis of determining the development of teachers' TSPCK. The study found that the critical engagement of the lessons resulted in an improvement of the teachers' TSPCK in the topic of stoichiometry. The impact of the Learning Study, in terms of the collective topic-specific PCK evident in a Professional Learning Community being enacted in the teaching practices

of the teachers in the Learning Study highlighted that they delivered significantly better lessons than a comparison group that did not work together collaboratively. Participation in a Learning Study with the explicit inclusion of TSPCK not only develops teachers' TSPCK but has a significant impact on the lessons delivered by the teachers working collaboratively. The study also contributes to the understanding of TSPCK enactment, and provides empirical evidence in terms of the emerging patterns during TSPCK enactment that supports the consensus model of teacher knowledge.

Key words: **Stoichiometry, Topic-specific Pedagogical Content Knowledge, Learning Study**