

## **Abstract**

Understanding teachers' professional knowledge is not a straightforward enterprise since it is comprised of both explicit and implicit interrelated set of knowledge and beliefs about the teaching and learning.

The main goal of this study was to examine in-service high-school biology teachers' professional knowledge, in the context of a long term professional development program. The study addressed both the explicit knowledge and the implicit knowledge of the participating teachers, using different qualitative methods. Initially, I characterized the biology teachers' professional knowledge using a representation that I developed during the course of this study. Aligning the professional knowledge components that emerged during the course of this study with previously published PCK components and analyzing the frequency of appearance of each PCK component in the teachers' data, enabled me to pinpoint specific PCK components and their expansion in the course of the teachers' professional development program. At the subsequent part of the research, I used the Repertory Grid Technique (RGT) to focus on the tacit biology teachers' professional knowledge and comprised it with the tacit dimensions of professional knowledge of teachers from other scientific disciplines (physics, chemistry, and mathematics).

Examining teachers' explicit knowledge revealed that the biology teachers mostly referred to two PCK components: teaching strategies and meaningful learning. Focusing on these two components revealed that teachers may hold different PCK, namely they refer to the same components but interpreted them differently. Moreover, by tracking teachers' repeated explanations about teaching and learning, I was able to determine each teacher's unique PCK orientation, thus clarifying and providing a practical meaning for the term orientation which was previously reported to be unclear.

Examining teachers' implicit knowledge revealed that CK is an important component of the teachers' professional knowledge although it was not one of the most discussed components in the teachers' episodes. Data analysis revealed that while most of the biology teachers as well as most of the chemistry and physics teachers did not integrate the new subject matter CK acquired during the program into their practice, the mathematics teachers largely connected CK to other categories of professional knowledge elements, especially to teaching strategies elements. That is, although mathematics teachers do not teach high mathematics contents in class their PCK can be meaningfully expanded by studying high level mathematics contents. In contrast, the biology teachers which have to stay updated with 4 new researches and new findings in biology are very interested in acquiring new CK, but it was probably not the main cause for their PCK expansion.

The conclusions of this thesis are that different teachers may hold different PCK orientations. These PCK orientations do not change over time but they are capable of expanding and may become more sophisticated. The expansion of each teacher's unique PCK orientation was driven by the teachers' need to examine different teaching strategies and learning abilities while designing the new teaching and learning materials. Retention of major parts of the expanded PCK following the termination of the program implies that designing and implementing new teaching and learning materials accompanied by biology and science education courses might provide a powerful means for PCK expansion. In addition, acquiring subject matter CK during professional development programs may differently influence teachers from different disciplines. Therefore, when discussing the place of CK in teachers' practice we should consider the differences between the various

disciplines while referring to each discipline separately because of the unique characteristics of each discipline.

There was no clear correlation between each teacher's repertory grid's outcomes and their PCK orientations. That result reinforces the conclusion that in order to examine teachers' professional knowledge comprehensively, science education researchers should examine both explicit as well as implicit knowledge.

The main implication that can be drawn from this research is that professional development program designers should consider focusing on each teacher's unique PCK orientation in order to appeal to each teacher's cognitive structure, thus minimizing rejection of newly acquired knowledge that does not correspond with the individual's existing constructs. Appealing to each teacher's unique PCK orientation may in turn reinforce effective professional development. In addition, professional development designers should consider not ignoring subject matter CK, which is a very important domain of biology teachers' professional knowledge. However, professional development programs designers should consider promoting the connection between biology teachers' CK and PCK instead of assuming that increasing CK will automatically improve PCK.