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By

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חקר פנים שונות בהתפתחות  
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כימיה

Development Aspects of the  
Professional Learning  
Community of Chemistry  
Teachers

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## **Abstract**

Teachers are essential to educational success, as research and educational work have proven again and again. Of the sciences learned at school, chemistry is among the most difficult to learn, and chemistry teachers in Israel face numerous challenges. The present research therefore focuses on chemistry teachers. To launch a process that would improve chemistry teaching and learning, a network of chemistry teachers' communities was set up, where teacher leaders are in charge of developing the professional skills of their colleagues within the community framework. The study investigates in depth various professional development issues over a period of five years, within the network of chemistry teachers' professional learning communities (PLC), which serves as a new model for professional development in chemistry teaching.

The chemistry PLCs have been operating in a network model since the 2015-16 school year. The network features a community of chemistry teacher leaders and community facilitators that meets every two weeks in the Weizmann Institute of Science. In the following week, the teacher leaders pair up and conduct meetings in close-to-home regional chemistry PLCs. The model includes training teacher leaders within the leaders' community under supervision of a team from the Science Teaching Department of the Weizmann Institute, and practicing leading close-to-home communities.

The research has three main purposes:

1. Examining the effect of participation in a chemistry teachers' PLC on the professional development of chemistry teachers
2. Investigating the role of the leading chemistry teachers' WhatsApp group on developing professional knowledge and a sense of community.
3. Gaining deep understanding of the process of identity change teacher leaders undergo, from classroom teachers to community teacher leaders.

To answer the first research question, we researched close-to-home communities. The research participants included about 50 teachers in the 2016-17 school year, and about 120 teachers in 2017-18. The participants had different levels of experience in chemistry teaching. A mixed research method was used, combining the qualitative and quantitative approaches. The main data were collected by online questionnaires

and were analyzed using a quantitative methodology (t test, F test,  $\chi^2$  test, correlations, and stepwise regressions). In 2018-19, teacher leaders conducted semi-structured interviews with 14 teachers. The interviews' content was analyzed using a qualitative methodology.

It was found that the close-to-home PLCs had a greater contribution to the participants' professional development than any other professional development framework. This applied to all the seniority levels. A possible explanation for this finding may have to do with the very high correlation between the trust existing within the community and the sense of greater contribution, especially among teachers with up to 18 years of experience. Notably, the teachers had significantly lower trust in their colleagues at school than in their community members. Trust is a basic element in an effective community. Many chemistry teachers who have no counterparts in their schools or ones who are not in good relations with their school colleagues feel safe to seek advice, share and discuss their problems, and collaborate with their colleagues only in the close-to-home community. Accordingly, we identified the strengths of the community and discussed the weaknesses that had to be overcome.

To attend to the second goal of the research, we investigated the role a community WhatsApp group played in the teachers' knowledge development and in generating a sense of community. To this end, we examined the WhatsApp group of the leaders' community in the years 2015-16 and 2016-17. The research population included the community members, namely, community facilitators, teacher leaders, and reserve teacher leaders. In the studied period, the community numbered 19-20 members (depending on the year). The netnographic approach was used to analyze the WhatsApp chats. The WhatsApp group's chats were divided into discourse episodes that were codified both bottom-up and top-down. The bottom-up analysis served to characterize the topics and purposes of the discourse, while the top-down analysis, which leaned on MacMillan & Chavis (1986) sense-of-community theory, helped identify the elements of the sense of community. It came up from the analysis that the community's WhatsApp group supported development of the four elements of the sense of community – membership, influence, fulfillment of needs and reinforcement, and shared emotional connection. We identified the growth mechanism of these elements, and formulated recommendations for the community facilitators with a

view to increase the sense of community among chemistry teachers in the PLC. Another finding was that WhatsApp could be used as a tool for assessing the community members' sense of community. To illustrate the mechanisms of knowledge development, we used two vignettes representing different cases of professional knowledge development in the WhatsApp group. The WhatsApp group was found to employ a unique mechanism that supported the teachers' knowledge development. Using this mechanism, experiences shared by the teachers in the WhatsApp group benefit other members of the teachers' community. The sharing influences the teachers' filtering or amplification of the new knowledge, and helps building knowledge, adopting new teaching practices, and enhancing the teachers' overall skills. Consequent to the research, we recommend adding the new technological-community mechanism to the theoretical knowledge development model proposed by Gess-Newsome (2015). Increasing awareness of this mechanism would help community facilitators to take a conscious decision to implement it, thus boosting the participating teachers' knowledge development and skill acquisition.

To address the third purpose of the research – the development of a teacher leader identity, four teacher leaders were selected, each representing one of the identity statuses identified by Marcia (1980). We used the case study methodology to follow their identity development over three years, utilizing diverse tools such as interviews, reflections and observations at community gatherings to collect rich data towards building the case studies. Data analysis revealed that identifying the identity status of the teachers could serve as a basis for devising a custom-made personalized program to develop the identity of teacher leaders. In terms of the resources required for developing a teacher leader's identity, further examination of the program revealed that the primary requirement for identity development was the opportunity to be held accountable while functioning as close-to-home community leaders. Other assets included being able to display competence as leaders in different settings, the very fact of being members of the leaders' community, and the support of the community facilitators and their peers in their professional knowledge development. A significant disadvantage was insufficient emotional support that could help the teacher leaders span the gap between their self-image and the leader figures they were aspiring to become. Significantly, the teachers' status as teacher leaders was found to boost their identity as chemistry teachers in class. This means that the program could be a

professional development track that would enhance the teachers' perseverance in the classroom, while also extending their influence beyond it.

From a broad perspective, the community network model and its associated technological platform can potentially prove to be effective in meeting the teachers' overall social, cognitive, emotional, and identity needs. It should be kept in mind that a community is a complex and sensitive structure, which requires addressing attentively the numerous challenges described in this work.