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CHEMISTRYLAB GADOLIN AS A RELEVANT LEARNING ENVIRONMENT FOR LIFELONG LEARNING

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Authentic, outside of school learning environments in chemistry have a central role both engaging students in chemistry as well as teachers' lifelong learning. In this case study, the relevancy of ChemistryLab Gadolin, non-formal learning environment that operates within the Unit of Chemistry Teacher Education in the Department of Chemistry, University of Helsinki, is being described from the point of view of future chemistry teachers. It is the oldest of the 12 science and technology classrooms for schools that operate under the LUMA Centre Finland. 10 student teachers, who are acting as guides for visiting students and teachers from different school levels, took part in a survey. The data was analyzed using a theoretical content analysis. This case study shows that ChemistryLab Gadolin is a relevant learning environment for future chemistry teachers from the dimensions of individual, societal and vocational relevance. It indicates that future teachers experienced ChemistryLab Gadolin as a significant learning environment that promotes their vocational development, both from the points of view of knowledge of chemistry and pedagogical content knowledge (PCK), and that strengthens their vocational selection. It is experienced to increase a future teacher's self-confidence in working with different kinds of learners and in guiding students towards inquiry, which is a central part of the nature of chemistry. Future teachers experience working in the Gadolin as significant and important also to teachers, all students and families visiting the Gadolin. ChemistryLab Gadolin's co-operations with companies are seen as increasing the societal significance of the ChemistryLab's operations for all visitors.

Keywords: non-formal learning environments, science communication, science education

INTRODUCTION

Teachers are the makers of the future. Encouraging and skillful chemistry teachers have a key role in encouraging children and adolescents towards studying chemistry, in increasing common knowledge in chemistry and seeing chemistry even more as a possible future profession. In order to reach the goal, we need new openings in supporting teachers' lifelong learning by strengthening the co-operation between pre-service education and in-service education as well as between the surrounding society (e.g. economic life) (The Finnish ministry of education and culture, 2016). We have received good results in Finland, with a new kind of a communal chemistry teacher education model in the LUMA ecosystem that connects the utilization of newest research information as well as formal, non-formal and informal learning and lifelong learning (Aksela,2016; Aksela & Vihma, 2015). Here, future teachers studying in the bachelor and master's degree levels in the evidence-based teacher education (Aksela, 2010), constantly get to interact through their studies in different LUMA activities (e.g. in the Gadolin) with children and adolescents, families, teachers, chemists and the working life (e.g. companies) with different forms of activities (e.g. instructing inquiry and molecular modelling in authentic science classrooms, science clubs, science birthdays and science camps). Theory and practice go hand in hand.

The relevance of chemistry learning environments is considered in this case study from the point of view of a model developed by Stuckey et al. (2013). A learning environment can be thought of as relevant, when future teachers' learning in the above mentioned learning environment has a positive impact on their studies and on their future. In this paper, the relevance of the ChemistryLab Gadolin as a learning environment for future chemistry teachers is being considered. According to the model, relevance can be evaluated in three different dimensions, which are *individual, societal and vocational relevance.*

CHEMISTRYLAB GADOLIN AS A LEARNING ENVIRONMENT

Authentic, outside of school non-formal learning environments may have an especially significant role and a mission in promoting chemistry teaching and studying (Affeldt et al., 2017; Tolppanen et al., 2015). This case study has been executed in the authentic science classroom, ChemistryLab Gadolin (http://h75.it.helsinki.fi/kemma-en/) that is a part of the operations of LUMA Centre Finland (http://www.luma.fi/news). It has four functions (Aksela & Ikävalko, 2016): (i) it acts as a learning place for kintergartens and schools while supporting the aims of the chemistry curriculum, (ii) a place of education for teachers and future teachers, (iii) a center of research and development for the Unit of Chemistry Teacher Education and (iv) a meeting place (e.g. families, researchers, the economic life and media). ChemistryLab Gadolin co-operates with the university as well as with companies in the branch of chemistry and with the Chemical Industry. ChemistryLab Gadolin is a place of education for future chemistry teachers: it operates as a studying place for their many courses and studies.

METHODS

This research was executed as a qualitative case study with the help of a survey. In the survey, the opinion of future teachers on the relevance of the learning environment for themselves, students, teachers, families and for Gadolin's 10 co-operating companies were mapped out. The survey consisted of open-ended questions. Data was analyzed by theory-based content analysis from the point of view of relevance theory. The acquired data was classified into relevance classes: *individual, societal and vocational.* The classes are being demonstrated with authentic examples. Each student taking part in the research, received a table of all the answers that had been divided according to the research questions (anonymously) and they had the chance to once add text and write comments on the topic. All 10 future teachers, who worked as instructors doing different tasks in the ChemistryLab Gadolin in 2017 (e.g. instructors of visiting students, planning the material for visiting groups together with teachers, developers of inquiry-based work, instructors for science clubs, camps and science birthdays) took part in the research.

RESULTS AND DISCUSSION

This case study shows that ChemistryLab Gadolin is a relevant learning environment for future chemistry teachers from the dimensions of individual, societal and vocational relevance (Table 1; Stuckey et al, 2013). The future teachers received diverse experiences, developed as teachers and made new friends with the other teachers. Mostly, they highlighted working in the ChemistryLab Gadolin as vocationally relevant.

TABLE 1. Examples of different dimensions of the relevancy of ChemistryLab Gadolin as a learning environment for future teachers in chemistry.

DIMENSIONS	EXAMPLE 1	EXAMPLE 2	EXAMPLE 3
INDIVIDUAL	***Useful for myself:*** *"Very useful for me."*	***Positive experiences:*** *"A lot of experience, which would have been nearly impossible to acquire from elsewhere along with studies."*	***Social community:*** *"I have made new friends in the Gadolin team"* *"So proud and happy that I have been chosen to the Gadolin instructor team"*
VOCATIONAL	***Strengthened their vocational selection and self-confidence:*** *"Has strengthened the feeling that the profession that I have chosen is really the one for me. I feel like this work has absolutely promoted my growing as a teacher. It has given me certainty in controlling a group, in using different kinds of teaching styles ..."* *"Without the experience of being a*	***Knowledge of chemistry increased:*** *"Knowledge of basic chemistry has strengthened hugely while instructing inquiry-based works and answering to children and adolescents' questions"* *"Working in the Gadolin helps*	***Strengthened their pedagogical content knowledge (PCK)*** *"Has taught me to use learning entities that cross the boundaries between subjects in a smooth way also in other kinds of teaching"* *"It has fed my creativity to further develop working instructions and to create new encouraging learning material."*

	Gadolin instructor, using laboratory work as a part of teaching in the future would have most probably been much more difficult, but now teaching inquiry does not cause any kind of uncertainty"	*in keeping the level high and in keeping personal abilities polished"*	*"I have learned to work with many different kinds of groups and different aged groups. There have been children with special needs, kindergarteners, students from vocational schools, IB programme students, lower secondary level students ..." "To apply a work instruction to fit a specific group of students; learned to better take the wishes and needs of specific groups into consideration and to plan a learning entity that corresponds to their level."*
SOCIETAL	***Ideas, positive experiences and interest for teacher students and families:*** *"For teachers, Gadolin gives ideas and material for executing encouraging teaching of chemistry, gives positive experience on natural sciences and intrigues, gives families hopefully a new positive point of view into natural sciences and its significance through the enthusiasm of children."*	***Ideas and knowledge of the opportunities of chemistry and its careers:*** *"To cooperation partners, Gadolin offers future experts in chemistry and to society it offers solutions to challenges of the future e.g. connected to fiscal sustainability, through the experts of the future."*	***New workers and solutions for the challenges of future through skillful workers for the collaborative companies:*** *"Has helped students and parents visiting here to acquire more information on the study possibilities of chemistry and what kinds of professions are possible with studies/a degree in chemistry."*

Future teachers experience the learning environment as relevant also to the visiting teachers, all students and families. Observing what the students do and reflecting on them in the ChemistryLab Gadolin offers teachers a new model for their in-service education. They are able to reflect on the teaching by observing their students and at the same time are able come up with new ideas (e.g. Nilsson, 2008), and they receive also new meaningful material for their own teaching. For families, it strengthens the meaning of natural sciences and brings enthusiasm.

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