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PRE-SERVICE CHEMISTRY TEACHERS' LEARNING ABOUT INTEGRATED SCIENCE EDUCATION BY COLLABORATION AND DESIGN

INTRODUCTION

Many science education researchers (e.g. Czerniak & Johnson, 2014; Samson, 2014; Wei, 2009) and curriculum reformers (e.g. Finnish National Board of Education, 2014; Next Generation Science Standards, 2013) promote the use of integrated approaches in teaching the key competences of the 21st century.

However, there exist barriers for implementing integrated education (=IE) into science classroom settings such as lack of planning time, rigorous timetables, school's community and teachers attitudes (Czerniak & Johnson, 2014; Samson, 2014).

Our study (Haatainen, Turkka & Aksela, 2017) on science teachers' perceptions on IE revealed also that teachers have a positive attitude towards IE, but they do not see the relevance of integration for the subject matter teaching. Thus, a need for research and models for relevant implementation of ISE exist.

The most efficient way to ensure research results and pedagogical models transferring into classroom practices is a long-term training that is closely linked with practice, includes reflection and offers peer support (e.g. Van Driel & Berry, 2012; Nilsson, 2014).

Here we describe a university course where this has been taken into account and where some of the main barriers of implementing IE could be avoided.

COURSE WITH DESIGN AND COLLABORATION

During fall semester 2016 we organized a master level course focusing on ISE. The course is one of the last courses pre-service chemistry teachers are expected to take and they are expected to have a solid understanding of chemistry and some pedagogical skills.

All course assignments related to the main task of designing in pairs and in collaboration with in-service teachers a unit plan implementing ISE and writing a research article about the process. The design was based on research on IE and as a process followed a single cycle of design-based research (Edelson, 2002).

The units consisted of two to four lessons of chemistry and other subjects (e.g. mathematics and home economics). The designed units were tested in schools.

Constant support, reflection and feedback opportunities during the design were offered to students. The students were given a lot of autonomy in designing their unit plan (e.g. context, teaching methods and materials). The appropriate chemistry content and other subjects to integrate into the unit lesson plan were discussed together with the collaborating teachers in schools.

CASE STUDY

A case study was chosen as a research method.

Research question:

- What are pre-service chemistry teachers' views about IE in the beginning and at the end of a course where they learn about ISE by collaboration and design?
- How pre-service chemistry teachers' attitudes towards ISE change during a course where they engage in design and collaboration?

Qualitative and quantitative data was collected during the whole course with various methods: pre and post questionnaire, students course works (unit plans and articles) and oral evaluation and interviews. transcriptions of the oral evaluation.

RESULTS

The initial results of the analysis of students pre- and post-questionnaire are presented here. The qualitative content analysis of students views on IE (table 1) indicates that IE is mainly defined as having interdisciplinary aspects in both pre and post questionnaire. The additional category refers to IE being somehow separate of subject teaching and/or adding something to it. This is the only category with less cases at the end of the course.

Table 1: Students views of IE found in pre- and post-questionnaire.

Categories of IE	Pre	Post
cognitive skills	0	2
context based	5	8
interdisciplinary	18	20
relevance	8	14
competence	8	8
student centered	0	8
additional	8	4

The attitudes (table 2) were measured by a set of 7 Likert scale (5-points) statements in the questionnaire. The reliability for the set was calculated (Cronbach's alpha= 0,856). A Wilcoxon signed-rank test indicates that the positive change in students' attitudes is significant (Z = -2,433, p = 0.015).

Table 2: Pre and post questionnaire Attitude Scores.

questionnaire	N	median	Z	p
pre	9	22	-2,433	0,015
post	9	26		

DISCUSSION

The results indicate that students' views about IE in the begin and at the end of the course are different, the latter showing more multi-dimensional views.

This course has offered many changes for reflection, peer review and it links studies to real classroom teaching settings, but further analysis is needed to reliably draw conclusions on the courses influence on students' conceptual understanding of IE. However, the course has had a significant positive effect on students' attitude towards ISE and this can increase the students' willingness to integrate when teaching science in the future.

References

Cherniak C.M. & Johnson C.C. (2014). Interdisciplinary Science Teaching. In Lederman & Abell (Eds.). *Handbook of Research on Science Education*. (395-410).

Edelson, D. C. (2002). Design research: What we learn when we engage in design. Journal of the Learning Sciences, 11(1), 105-121.

Finnish National Board of Education (2014). The National Core Curriculum for Basic Education 2014. Helsinki: Finnish National Board of Education.

Haatainen, O., Turkka, J. & Aksela, M. (2017) Science Teachers' Perceptions on Integrated Science Education. Manuscript in preparation.

NGSS Lead States. (2013). Next generation science standards: For states, by states

Nilsson, P. (2014). When teaching makes a difference: Developing science teachers' pedagogical content knowledge through learning study. *International Journal of Science Education, 36*(11), 1794-1814.

Samson, G. (2014). From Writing to Doing: The Challenges of Implementing Integration (and Interdisciplinarity) in the Teaching of Mathematics, Sciences, and Technology. *Canadian Journal of Science, Mathematics and Technology Education, 14 (4)*, 346 -358

Van Driel, J. H., & Berry, A. (2012). Teacher professional development focusing on pedagogical content knowledge. *Educational Researcher, 41*, 26-28. doi:10.3102/0013189X11431010

Wei, B. (2009). In Search of Meaningful Integration: The experiences of developing integrated science curricula in junior secondary schools in China. International Journal of Science Education, 31(2), 259-277