



SUPPORTING PRE-SERVICE CHEMISTRY TEACHERS IN TECHNOLOGY-ENHANCED INQUIRY

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CONTEXT

This research was conducted during a pre-service chemistry education course *Inquiry-based Chemistry Teaching 1* (IBCT 1). This Bachelor's level course was held in Spring 2014. It was designed to provide pre-service teachers (PST) preliminary skills in designing and conducting inquiry activities and using microcomputer-based laboratory (MBL) technology to support the inquiry activities. The aim of this research project was to evaluate the effectiveness of the course design used to support inquiry-based chemistry teaching (IBCT).

THEORETICAL BACKGROUND

MBL tools have central role in chemistry education^{1,2} and they are also suggested for inquiry-based activities³. To promote change in PSTs' knowledge and practices, their practical knowledge (PK) must be changed⁴. Their existing ideas about teaching must be challenged, and examples of working and pedagogically meaningful teaching methods need to be provided⁵. Technology-enhanced inquiry can be promoted by providing opportunities to design, implement and evaluate activities relevant for inquiry in general⁶, and for technology-enhanced inquiry⁷.

Table 1. The structure of the IBCT course

Week	Critical element	Topic
1	Inquiry-based teaching	Lesson: Introduction to inquiry-based learning
2		WA1: inquiry-based chemistry teaching
3 (PST 1 away)	MBL-enhanced inquiry	Introduction to MBL. WA2: using MBL in chemistry education.
4	Learning about inquiry	PTE: Conducting background research and defining a research question
	Inquiry-based teaching	Lesson: Levels of inquiry and supporting students' high-order thinking
5	Learning about inquiry	PTE: Designing an experiment with the available equipment.
	Inquiry-based teaching	PTE: Drawing conclusions based on evidence.
		WA 1 is due.
6	Learning about inquiry	PTE: Learning to use MBL in inquiry-based activities
	Inquiry-based teaching	PTE: Learning to understand nature of scientific research.
	MBL-enhanced inquiry	Lesson: Example of inquiry-based MBL activity.
7	Learning about inquiry	PTE: Communicating the research results and to evaluate them critically.
	Inquiry-based teaching	PTE: Communicating the research results and to evaluate them critically.
	MBL-enhanced inquiry	Period break. WA 2 is due.
9 (PST 2 away)	Inquiry-based teaching	Lesson: Discussing the use of MBL activity of week 6.
10	Inquiry-based teaching	Lesson: Adapting an existing laboratory work to an inquiry-based activity.
11	Inquiry-based teaching	Preparing for teaching exercises.
12	Inquiry-based teaching	Preparing for teaching exercises. Teaching exercises begin.
		Lesson: Introduction to inquiry-based demonstrations and designing video demonstrations.
		WA3: creating inquiry-based activities based on Finnish chemistry curriculum. (Teaching exercises continue.)
13	Inquiry-based teaching	Lesson: Discussion on inquiry-based demonstration videos continue. Working on demonstration videos begins.
14	Inquiry-based teaching	Working on demonstration videos.
15	Inquiry-based teaching	Easter holiday. WA 3 is due.
16	Inquiry-based teaching	Presenting the demonstration videos. Feedback on course is collected.

PTE = peer-teaching exercise, MBL = microcomputer-based laboratory, PST = pre-service teacher, WA = written assignment

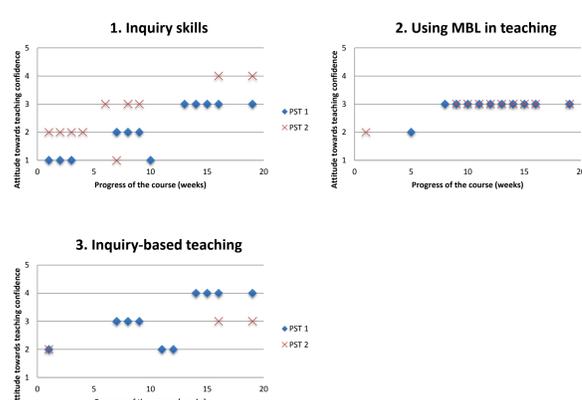
The IBCT 1 course is evaluated in the design-based research framework¹. The critical elements, on which the data analysis is based⁹, are presented in Table 1.

RESEARCH QUESTIONS

Table 1 also describes different supporting the implementation of the critical elements. The research presented here aimed at defining key experiences in the development of PSTs' PK related to MBL-enhanced inquiry. Two research questions were:

1. How did the PSTs describe changes in their PK during the course?
2. What kind of experiences were relevant for the felt changes in PK?

Two PSTs were interviewed 3 weeks after the course using semi-structured interview. To narratives of their experiences, PSTs were asked to generate storylines¹⁰ for 3 areas of PK relevant for the critical elements.



Graphs 1-5. PSTs' storylines of their experiences during the course.

The interviews were transcribed from the audiotapes. The transcribes were analyzed to discover relevant experiences the two PSTs had during the course. Both PSTs were in Bachelors' degree stage and majoring in chemistry. They had studied chemistry less than three years.

RESULTS

These storylines for 3 areas of PK are presented in Graphs 1-3. Together with analysis of interviews, the storylines suggest

that the felt that IBCT 1 course enhanced their abilities on all three aspects. The analysis also showed that the effects of critical elements were not as intended. The WA 1 did not help PSTs to understand IBCT. Experiences developing this understanding came only later, when the two PSTs had opportunities to see examples of how others conducted PTEs and when they had chance to design IBCT activities for students. However, PTEs were not as effective in supporting inquiry skills as intended when designing the critical elements.

Even though several activities were designed for supporting students' skills in MBL-enhanced inquiry, only the three PTEs using MBL were mentioned by either of the PSTs. Bot had mainly experiences related to learning technical use of MBL tools. Pedagogical aspects of MBL were discussed only by PST 2. Even as weeks 9-12 were designed to provide IBCT experiences, PSTs discussed mainly experiences related to inquiry skills. Opportunities to adapt existing material was found to be important experience for learning about inquiry, not for inquiry-based teaching, although PST1 stated that demonstration activity was so positive experience that it enhanced her positive attitude towards IBCT.

CONCLUSIONS

IBCT 1 course provided practical experiences that made PTSs feel better about their skills at the end of the course than at the beginning. This may be related to the serious difficulties in understanding the concept of IBCT at the beginning.

It is noteworthy that the PTE mentioned by both PSTs as important (week 6) for their attitudes towards all three aspects, was held by students in far beyond the bachelor's stage. This suggests that even as designing and implementing teaching activities is important for the development of skills, PTE may not be effective unless the peer has sufficient PK about IBCT. One possible change could be creating PTEs in collaboration with in-service teachers¹¹.

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