



SUPPORTING FUTURE CHEMISTRY TEACHERS' PROFESSIONAL DEVELOPMENT OF RESEARCH-BASED TEACHING VIA DBR

University lecturer, Dr. Johannes Perna & prof. Maija Aksela



THE UNIT OF CHEMISTRY TEACHER EDUCATION

- Est. 2001 (17 years)
- Professor position 2008
- Few hundred chemistry teachers graduated

- **Mission:** Research-oriented inspirational chemistry teacher
- **Vision:** National trend-setter, respected research team
- **Core values:** Student in heart, life long learning, courage, collaborative development, sustainable thinking & ICT

- <http://blogs.helsinki.fi/kem-ope/en>



CONTENTS

DBR

**PROGRESSIVE RESEARCH SKILL
STRUCTURE IN CHEM ED. COURSES**

STEP-BY-STEP DBR APPROACH

METHODS

DATA EXAMPLES

CONCLUSIONS

REFERENCES



DESIGN-BASED RESEARCH

- Enables research-based development
 - Development of a theory
 - Draw design principles from theory
 - Concrete artefacts as a result
 - Courses, learning materials, software etc...
 - Evaluation of a designed outcome
 - Design decisions
 - Problem analysis (needs assesment)
 - Design procedure
 - Design solution
- Research driven
 - Iterative
 - Systematic documentation
 - Formative evaluation
 - Generalization

Cobb et al., 2003; Edelson, 2002; Perna, 2013



EDELSON'S MODEL

- Problem analysis
 - Often at the beginning
 - Need analysis for the design
 - goals, challenges, opportunities
 - context-based
- Design solution
 - Description of the design outcome
 - e.g. courses, materials, processes
- Design process
 - Describes the whole process

- Practical
- All phases generates new knowledge
- Excellent tool for life-long research-based teaching

Edelson, 2002



FUTURE CHEMISTRY TEACHERS AS RESEARCHERS – A PROGRESSIVE APPROACH

- **1. year**
 - First bite in research literature
 - Writing a summary
 - Open data, mixed method project
 - Blog, learning diary
- **2. year**
 - Essay
 - Information seeking
 - Small research report
 - Questionnaire / interview
 - Case study
 - Development of learning materials for lab context
- **3. year**
 - Content analysis
 - Development of learning material
 - Column
 - Bachelors thesis
- **4. year** (pedagogical studies)
 - Small research project
- **5. year**
 - Design-based research
 - Research article
 - Masters thesis

Aksela, 2010



STEP-BY-STEP APPROACH TO DBR

- **1. year**
 - Development of learning materials
 - Research paper
 - Textbook analysis
 - Evaluation by peers
- **2. year**
 - Development of learning materials
 - Research papers
 - Textbook analysis
 - Evaluation in a non-formal learning environment
 - ChemistryLab Gadolin
- **3. year**
 - Theory of DBR (BASICS)
 - Development of learning materials
 - Research papers
 - Textbook analysis
 - Evaluation in a non-formal learning environment
 - ChemistryLab Gadolin
 - DBR report
- **5. year**
 - Design-based research (FULL version)
 - Molecular modelling context



INITIAL RESEARCH QUESTIONS

- How to introduce DBR in teacher education?
 - Design process
 - What can be learned from the design process?
 - Design solution
 - Description of the STEP-BY-STEP DBR model
 - Problem analysis
 - What are the possibilities and challenges of the use of DBR in teacher education?



METHODS

- Collaborative design process
- Questionnaire
 - All students evaluates the relevance of all activities in every course
 - Yearly
 - So far 51 responses
- Qualitative content analysis
 - **We are in this stage**
 - **We also need to clarify the theoretical framework**



DATA EXAMPLES

- Positive

- *"DBR was useful from the master's thesis point of view."*
- *"DBR could be a good way to work in other courses even though we have small data samples."*
- *"Redesigning learning materials to support more the inquiry-based approach is a good way to develop recipe like lab works into more motivating form."*

- Challenge:

- *"It was fun and interesting to design laboratory activities, but carrying out a design research was not useful. I did not learn anything by filling in the design research template, but designing the lab work was really useful. Whole design research process could have started earlier and we could have fill in the template together. Then I think I could have learnt more."*



NEXT STEPS

- Next iteration of the step-by-step approach
 - When to introduce the DBR terminology?
 - How the big picture is introduced that it won't arouse anxiety?
 - Documentation of the design decisions
- What could be the suitable theoretical framework for the analyzing / understanding this massive qualitative data?
 - The method is well known.
- DBR about the introduce the DBR for students
 - Where to publish?
 - LUMAT Special Issue?



REFERENCES

- Aksela, M. (2010). Evidence-based teacher education: becoming a lifelong research-oriented chemistry teacher? *Chemistry Education Research and Practice*, 11(2), 84–91.
<https://doi.org/10.1039/C005350N>
- Cobb, P., Confrey, J., diSessa, A., Lehrer, R., & Schauble, L. (2003). Design Experiments in Educational Research. *Educational Researcher*, 32(1), 9–13.
<https://doi.org/10.3102/0013189X032001009>
- Edelson, D. C. (2002). Design Research: What We Learn When We Engage in Design. *The Journal of the Learning Sciences*, 11(1), 105–121.
- Perna, J. (2013). Kehittämistutkimus tutkimusmenetelmänä. Teoksessa *Kehittämistutkimus opetuslalla (Design-based research in education)* (pp. 9–26). Jyväskylä: PS-kustannus.