Research and Development in Computing Education

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What is learning?

- Transmitting knowledge from lectures and course material to students' heads is a heavily error prone process
- Students build their own mental models based on the absorbed information
  - The models may or may not work correctly (Norman, 1983)
- *Teacher's main task is to direct and support the learning process so that students build viable mental models.* For example:
  - Presentation of appropriate conceptual models (Ben-Ari, 2001)
  - Designing tasks for testing the mental models and giving feedback on them
- Research training does not support learning such work (!)

Research in learning / teaching

- Main challenge: How can research aid in improving the learning process ?
  - How to measure / evaluate learning results reliably
    - What does it tell us, if a student gets a grade 76 / 100?
  - How could we understand the learning process better in order to better guide it?
- My case field is Computing Education Research (CER)

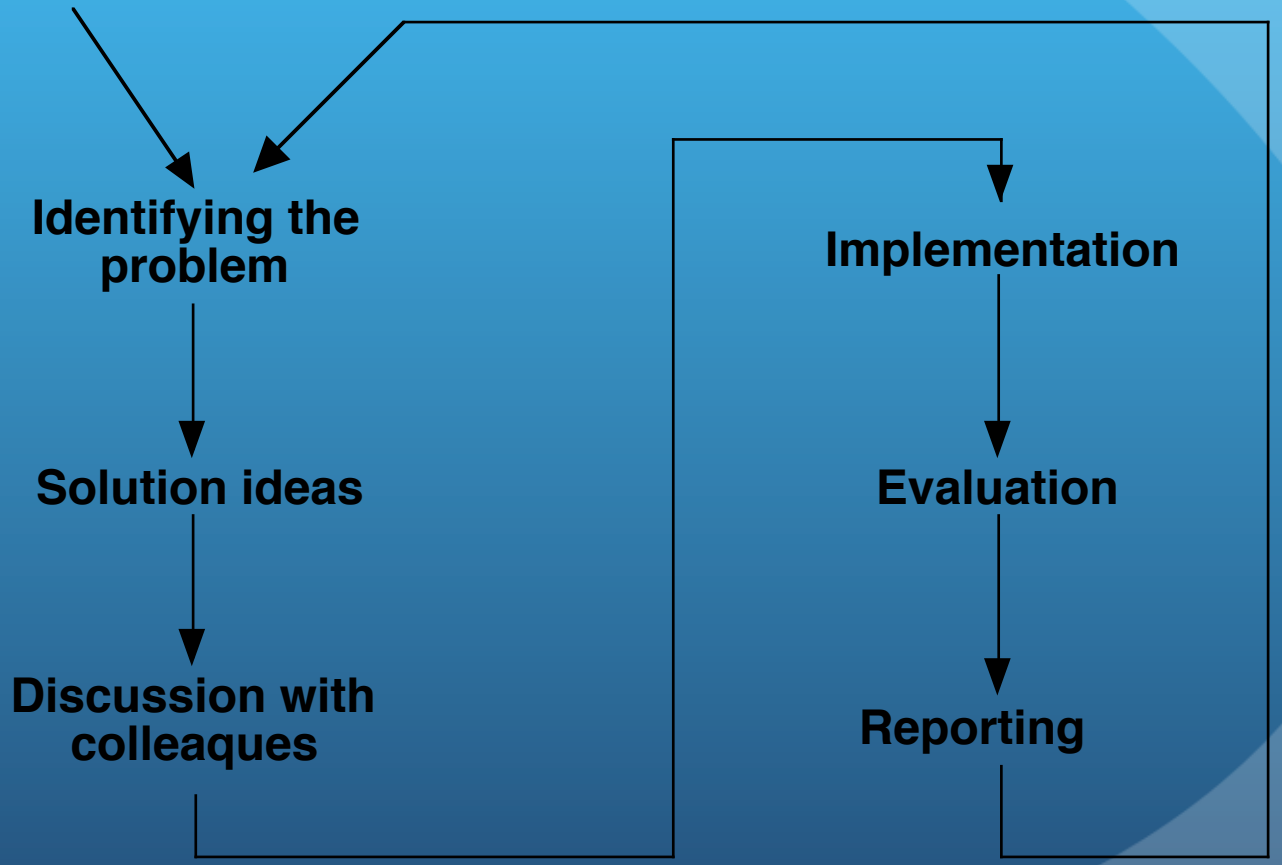
Whose field?

- Theories and research methods of learning fall in the fields of educational and social sciences.
  - Ordinary CS teachers have often only a vague figure of relevant learning theories.
  - Research methods may be totally unknown.
- Researchers in education do not know enough of computing.
  - Interdisciplinary collaboration is necessary.

From developing education towards research in education

- All teachers develop their education in various ways
  - New course contents and course material
  - New tasks, exercises, projects etc.
  - New teaching methods
  - New learning process

Systematic development in education



Steps towards research 1

- Not only notes about observations. Let us publish this!
- Publishing means much higher requirements for quality
  - What have others done?
  - What are my research questions?
  - What research methods should I use?

Steps towards research 2

- Participating conferences and workshops in your field of education
  - Getting to know other teachers / researchers
  - Understanding the cultural differences in education in other universities and countries
  - Comparing your own work with work of others
- Preparing theses on one's work
- *All this is totally normal for "ordinary research"*

Steps towards research 3

- Try to look at your teaching from the same perspective, as you do in other research.
- Your goals can include, e.g,
  - better understanding a phenomenon (learning CS)
  - developing models, tools and methods to aid gaining this understanding
  - improve a process (learning process) and its outcomes
  - generate and test hypotheses concerning the process and outcomes
- And your results should be generalizable

Quality of research 1

- CER is a new field. Development of CS education is not.
- Research tradition in emerging phase
- What is the main goal conference participants?
  - Exchange of ideas and experiences?
  - Presenting research and results?
- Practise paper vs. Research paper

Quality of research 2

- Dissertation is an obvious demonstration of a research field.
  - What is the quality of work?
- Interdisciplinary approach is obvious (computing, educational sciences, social sciences, psychology)
  - Appropriate research methods are diverse.
  - But what is the requested level in cross-disciplinary theses?

Quality of research 3

- Crucial issues:
  - Read relevant literature
  - Define your research problem well
  - Choose your research approach / methods and give arguments of your choice.
  - Follow good scientific practices
- Challenges
  - All research methods are not acceptable for people from tradition of “hard sciences”
  - You may have to defend the right to do research in the way you have chosen.

What can development of education give to research?

- New ideas for exploration and evaluation
  - New teaching methods
  - New ways of presenting topics
  - New software and learning technology
  - …
- Raw data (results, feedback, students' submitted works) for analysis.

What can research in education give to education?

- Are you sure that your new tools / methods / ... really contribute to learning?
- Can you convince your colleagues that the new methods, tools, approaches really promote learning?
- How to better understand students' conceptions / misconceptions on topics they are learning?
- Better arguments for your teaching approach
- Evaluation methods and results
- *In any case, it is worth following the literature!*

Some journals

- Journal of Engineering Education
- European Journal of Engineering Education
- Computer Science Education
- ACM Transactions of Computing Education
- IEEE Transactions on Education
- IEEE Transactions of Learning Technologies
- Computers & Education
- British Journal of Educational Technology
- Journal of Chemical Education
- Chemistry Education Research and Practice
- Journal of Management Education
- International Journal of Art & Design Education

Some EER and CER conferences

- Frontiers in Education (FIE)
- Annual SEFI conference
- American Society for Engineering Education conference (ASEE)
- Research in Engineering Education Symposium (REES)

- Innovation and Technology in Computer Science Education (ITiCSE)
- International Computing Education Research conference (ICER)
- Koli Calling – International conference in computing education research

Assignment

- Goal: Get some view of publications in your own field of education
- Task: Choose one of the journals and browse papers published in 2013-2014.
- Select two different types of papers, which you find interesting

Assignment cont.

- Write a short (1000 words) of the papers where you discuss
  - Goals / research questions of the paper
  - Motivation for the work. What is the problem addressed?
  - What data is collected and how it is analysed, if there is an empirical part in the work?
  - Are there any learning theories / models in the background?
  - What are the central results and conclusions?
  - How can the results be applied in teaching practice?
- Return to XX by YY
- Be prepared for discussing the papers with your peers on this course, based on reading some of the summaries.

Thank you!