3D PRINTING IN CHEMISTRY EDUCATION

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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

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3D PRINTING

Prototyping

Manufacturing

Spare part industry
TPCK

- Pedagogical Knowledge (PK)
- Technology Knowledge (TK)
- Content Knowledge (CK)
- Pedagogical Content Knowledge (PCK)
- Technological Content Knowledge (TCK)
- Technological Pedagogical Knowledge (TPK)
- Technological Pedagogical Content Knowledge (TPACK)

Helppolainen & Aksela, 2015; Koehler et al. 2009; TPACK.org
METHODS

- RQ: How is the 3D printing applied in chemistry education analysed from the TPCK point of view?

- Information retrieval
  - Google Scholar, "3D printing" and "chemistry education“, 12/97
  - Scopus, "3D printing" and "chemistry education“, 23/121
  - ERIC, ”3D AND printing AND chemistry”, 21
  - Taylor & Francis, 3D printing / chemistry / education, 0/123
  - DOAJ, 3D AND printing AND chemistry AND education, 3 / 0

- Classification via qualitative content analysis
  - Content-based for use cases
  - Theory-based for TPCK
RESULTS – OVERALL VIEW

• **Altogether 33 papers** (31.5.2018)
  • 2 research papers
    – Biochemistry: how to support the understanding of macromolecules
    – Pharmacy: students’ experiences towards 3D printed models (PILOT)
  • 1 safety evaluation
  • Major groups
    – Printing context
      – What can be printed?
      – What topics are needed to be printed?
    – Printing process & software (methodology)
      – How to print?
      – Data flow schemas
RESULTS – TPCK

• Technological Content Knowledge (TCK)
  • Content knowledge
    – What should be printed?
  • Technological knowledge
    – How to print?

• Technological Pedagogical Content Knowledge (TPCK)
  • Why print 3D models in chemistry learning?
  • Why plastic models and computer based 3D models are not sufficient enough?
NEEDS FOR 3D PRINTED MODELS IN CHEM ED.

• “Existing teaching tools for learning typically difficult concepts that currently lack physical models.” (Smiar, & Mendez, 2018)

• “Tangible models help students and researchers visualize chemical structures in three dimensions (3D)” (Scalfani, & Vaid, 2014)

• “incorporation of p orbital isosurfaces into the models enables students in introductory organic chemistry courses to have hands-on experience with the concept of orbital alignment in strained and unstrained π systems.” (Carroll, & Blauch, 2017)
DISCUSSION

• 3D printing in chemistry education engages the whole TPCK model
  • The field is developing mostly from the Technological Content Knowledge (TCK) point of view.
    – What is needed to print and how it is done?
  • Pedagogical arguments / needs are not rationalised via systematic research.

• Some future research topics
  • How the use of computer-based models can be supported via concrete models? (e.g. Al-Balushi, & Al-Hajri, 2014; Mohamed-Salah, & Alain, 2016)
    – Modelling contexts have already been analysed.
  • Is 3D printing experienced as relevance technology? (see Stuckey et al. 2013)
    – For example, how does 3D printing effect on learning motivation?
    – How to minimize plastic waste via 3D-printing?
REFERENCES


