Jesper’s Blurps

# Teaching formats and technologies in physics education

Our work includes developing and testing both teaching formats and teaching technologies in physics education. We see a teaching format as a structured way of planning and performing teaching. We work extensively with formats that emphasize student agency and autonomy in the learning process, for instance inquiry-based models and scenario-based models. We see teaching technologies as practical applications of educational research, which affords knowledge, skills, and strategies for both teacher and student. Technologies include a diverse set of applications, such as the use of pen and paper, of different types of teaching/learning activities, and of computer software. Technology is for us embedded in teaching and serves an identifiable purpose.

**Example research questions**

**Examples publications**

Bruun, J., Andersen, I. V. K., Alavi, K., Harder, S., & Holm-Janas, V. (2022). Marsbasen: Eksempler på alibi for undersøgelser i fysik C i gymnasiet. I T. Hanghøj, M. Misfeldt, J. Bundsgaard, & V. Hetmar (red.), Håndbog i scenariedidaktik (1 udg., s. 285-298). Aarhus Universitetsforlag.

Madsen, L. M., Evans, R. H., & Bruun, J. (2020). Undersøgelsesbaseret undervisning: 6F modellen, dens tilblivelse og udvikling i Danmark. MONA - Matematik- og Naturfagsdidaktik, 1, 26-45. <https://tidsskrift.dk/mona/issue/view/8561>

Bruun, J., Ray, P. J., & Udby, L. (2019). Network analyses of student engagement with on-line textbook problems. *arXiv preprint arXiv:1903.11390*.

Overgaard, J. H., Bruun, J., May, M., & Udby, L. (2017). Virtual neutron scattering experiments: Training and preparing students for large-scale facility experiments. Læring og Medier (LOM), 9(16), 1-28.

Bruun, J., & Christiansen, F. V. (2016). Kinaesthetic activities in physics instruction: Image schematic justification and design based on didactic situations. NorDiNa: Nordic Studies in Science Education, 12(1), 56-72.

# Formative assessment and competencies in physics education

Formative assessment is one of the key strategies for physics teachers to help students develop their competencies in physics. We define competency in physics as the ability and will to to act, alone and with others, using curiosity, knowledge, skills, strategies, and meta-knowledge as these apply to physics, to negotiate meaning, to develop a distinct identity within the field of physics, and to participate in relevant decision-making situations. In formative assessment, teachers and students work together to identify students’ current levels of competencies and to design goals and tasks that will help students develop their competencies in physics even further. We work in different modalities, including, written, oral, kinaesthetic, computer-based, teacher-student, and peer assessment. Formative assessment in our view is tied to motivation, particularly, self-determination theory.

**Example research questions**

**Examples publications**

Bruun, J., & Evans, R. H. (2020). Network analysis of survey data to identify non-homogeneous teacher self-efficacy development in using formative assessment strategies. Education Sciences, 10(3), 1-21. <https://doi.org/10.3390/educsci10030054>

Ellegaard, M., Damsgaard, L., Bruun, J., & Johannsen, B. F. (2018). Patterns in the form of formative feedback and student response. Assessment and Evaluation in Higher Education, 43(5), 727-744. <https://doi.org/10.1080/02602938.2017.1403564>

Dolin, J, Bruun, J, Nielsen, SS, Jensen, SB & Nieminen, P 2018, The Structured Assessment Dialogue. i J Dolin & R Evans (red), Transforming Assessment: Through an interplay between practice, research and policy. 1 udg, bind 4, Springer, Switzerland, Contributions from Science Education Research, bind 4, s. 109-140. <https://doi.org/10.1007/978-3-319-63248-3_5>

# Advanced analytical tools for mixed methods research

The fields of physics and computer science continuously develop sophisticated tools for collecting and analyzing data quantitatively. DSE’s PER group aims at combining these tools with strong qualitative traditions in educational research to produce profoundly new knowledge about educational systems. A key direction is to investigate network analysis as a methodological tool for uncovering subtle but important patterns in data; for instance, student group formation patterns, navigation patterns in web-based teaching materials, or text-analysis with linguistic networks. Our current research also investigates how to enhance analyses of classroom video, classroom audio, and student generated products from teaching using, for example, machine learning techniques. An important part of our strategies for analyses is to intertwine qualitative and quantitative analyses; qualitative analyses provide us with the means to interpret quantitative patterns and vice versa.

**Example research questions**

**Examples publications**

Bruun, J., Andersen, I. V. K., & Udby, L. (2021). Network Analysis of changes to an integrated science course curriculum over time. I O. Levrini, G. Tasquier, T. Amin, L. Branchetti, & M. Levrin (red.), Engaging with Contemporary Challenges through Science Education Research: Selected papers from the ESERA 2019 Conference (1 udg., s. 91-104). Springer. Contributions from Science Education Research Bind 9 <https://doi.org/10.1007/978-3-030-74490-8_8>

Bruun, J., & Andersen, I. V. K. (2017). Network maps of student work with physics, other sciences, and math in an integrated science course. arXiv.org: Physics Education, 1-4. [1708.01389 ]. <https://arxiv.org/pdf/1708.01389>

Bruun, J. (2016). Networks as integrated in research methodologies in PER. I D. Jones, L. Ding, & A. Traxler (red.), 2016 PERC Proceedings (s. 11-17). [2] American Association of Physics Teachers. PERC Proceedings <https://doi.org/10.1119/perc.2016.plenary.002>

Bruun, J., & Bearden, I. (2014). Time Development in the Early History of Social Networks: Link Stabilization, Group Dynamics, and Segregation. P L o S One, 9(11), [e112775]. <https://doi.org/10.1371/journal.pone.0112775>