Flipped learning in science education

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FLIPPED LEARNING IN SCIENCE EDUCATION

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Over the past decade, massive investment in ICT has been made in Danish schools. Yet there is a need to rethink how to better integrate ICT in education (Bundsgaard et al. 2014 p. 216).

Flipped learning could prove an effective and meaningful way of unleashing the didactic potential of ICT.

Our research questions are: 1) “To what extent can teachers’ use of the FL teaching method improve Danish students’ learning outcomes in the subjects of physics/chemistry, biology and geography as measured by the results of national tests?” and 2) “What factors influence whether flipped learning improves students’ learning?”

Over a three-year period, 84 science teachers at 18 schools will participate in a programme focused on learning to conduct teaching based on flipped learning principals.

The teachers will participate in a 3 + 1 + 1 day course where essential technical and didactical issues regarding flipped learning will be addressed. The course will be followed by an array of scaffolding activities, including individual supervision, the sharing of materials used in lessons and the involvement of local school leaders in the programme.

During this three-year period, we will follow the progress of the students involved in the programme and monitor whether their science skills develop faster than those of similar students not involved in the programme. To do so, we will include both qualitative and quantitative methods in a mixed methods setup.

This poster presentation will present the methodological framework of a study on the implementation of flipped learning in science classrooms in the Danish secondary school system.

Keywords: Flipped learning, Science education

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Background and research questions

The potential of flipped learning in relation to differentiated teaching is reflected in the growing literature, including Bergmann and Sams (2012) and Keengwe (2014). Both of these books are, however, guidebooks by practitioners for practitioners.

Theoretically, it could be argued that there is evidence that flipped learning has positive, measurable impacts. The arguments can be divided into three themes: didactic, pedagogic and learning theory. The arguments are all based on the assumption that the method releases time for teachers and students in the classroom by allowing the students to see and work with training videos at home prior to the class. The time aspect is central in relation to students’ science learning, since increased class time permits more inquiry-based instruction, which has been shown empirically to have a positive learning effect (Schroeder et al., 2007; Slavin et al. 2012; Furtak et al. 2012; Minner et al. 2010).

The didactic argument concerns the potential of flipped learning to support teachers in their reflections on how they plan and conduct their teaching. According to the model, the initiation and scaffolding of students’ learning and their reflection on the topic starts before the classroom teaching. The teacher can gain insight into students’ academic level through the opportunities flipped learning provides for planning and carrying out investigative and problem-based learning in the classroom (Hattie, 2013).
The pedagogic argument is based on experience and activity. Here it is argued that focusing on students’ active role in the learning process results in a practical anchoring in both the problem-oriented and the investigative element (Bruner, 2004; Dewey, 2005).

The learning theory argument is based on a constructivist approach inspired by Illeris (2006). Students’ active work is a fundamental element of effective learning (Helmke, 2013). A shift in emphasis in education from students passively listening to the teacher towards students being more active and cooperating with each other and the teacher on the background of common knowledge allows students to progress more quickly towards greater understanding and knowledge (Barak and Shakhman, 2008).

We will use the following two questions to examine whether the implementation of flipped learning can create better science education in the Danish secondary school:

1. To what extent can teachers’ use of the flipped learning teaching method improve Danish students’ learning outcomes in the science subjects of physics/chemistry, biology and geography as measured by the results of national tests?

2. What factors influence whether flipped learning teaching improves students’ learning?

**Research Design**

The overall research design is based on an intervention and an analysis using a ‘mixed methods’ approach.

In the effect study of the intervention (research question 1), mainly registry data are used together with student surveys. The effect of the teaching method as experienced by students, teachers and educational leaders is elucidated using questionnaires and focus group interviews that explore why and when flipped learning teaching works (research question 2).

The study is carried out with the acceptance of 18 schools in four municipalities, where approximately 170 classes (involving 84 science teachers) will be taught using flipped learning in science subjects of biology, physics/chemistry and geography.

We have used specific queries to select the intervention classes. To account for the bias inherent in a non-random selection of intervention classes, we will conduct a proportionality test to ensure that the sample has approximately the same properties as a simple random (representative) sample. The test can be used to correct any disproportions in important background characteristics in intervention classes as compared to known distributions of the total population (e.g. teachers’ gender, age, seniority; the location of schools; class size; parental background).

**Analysis Strategy**

The analyses use ‘mixed methods’ and are conducted using classic quantitative hedged contrasts, which are subsequently sought explained or elaborated through questionnaires and qualitative focus group interviews.

Whether the students’ national test scores improve significantly (research question 1) will be assessed using a statistical analysis of student performance adjusted for socioeconomic differences. The test results of the three science subjects will be analysed together and separately.

The variables from the quantitative data collection will be analysed using proven ANOVA analysis methods, since it is expected that data from national tests will continue to be regarded as measures of achievement (so-called Rasch scores).

The educational leaders’ responses to the questionnaires will be graded on a Likert scale. The focus group interviews with selected groups of students and teachers will be transcribed. Interviews will be encoded in Nvivo and analysed to categorise the informants’ experiences of why and when flipped learning works in
teaching. We will use grounded theory (Charmaz, 2006) because it provides ideal methods to discover and develop an answer to research question 2. We will also use case studies (Ramian, 2007) to describe and explain the various outcomes of flipped learning in relation to different types of teachers (Stake, 2000).

REFERENCES


