Flipped learning in science education

PGCE Secondary Biology 2020-2021
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1 INTRODUCTION - What is flipped learning?

Teaching strategy that involves the use of pre-classroom activities to provide direct instruction. As a result, students come to lessons prepared, freeing up class time to focus on beneficial learning activities (Figure 1) (Straw *et al.,* 2015).

2 Why flipped learning?

Research shows how there are **benefits** to flipped classrooms:

- When used effectively, it can support the learning of all learners by allowing students to take ownership of their learning (Covill *et al.,* 2013).
- Research shows how pupils at KS2 slightly improved attainment in mathematics (Rudd *et al.,* 2017) and at KS3 in science (Say and Yildirim, 2020).
- Further impacts on learning are summarised in Figure 2 (Straw *et al.,* 2015).

Research underlines **challenges** to flipped classroom:

- Technology barriers (Bergman and Sams, 2015, pp 9 -22)
- Students' lack of engagement in the pre-task (Covill *et al.,* 2013
- A lot of work is needed up front (Covill *et al.,* 2013)

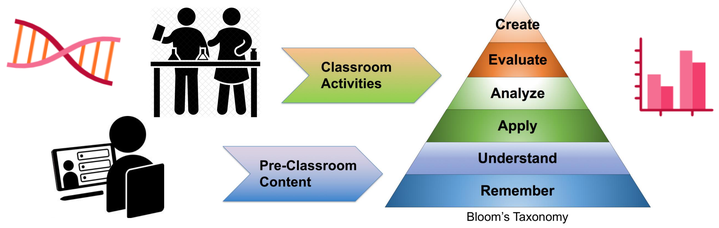


Figure 1 - Flipped learning model and Bloom's Taxonomy – Source: Educationaltechnology.net

FLIPPED LEARNING — Students learn at home and come prepared for lessons with a higher level of understanding and knowledge of the topic.

IMPACTS ON TEACHING AND LEARNING — Effective use of classroom time allows more time for:

- Practicing and applying knowledge
- Questioning and higher level discussions
- Collaborative learning and independent learning
- Individualised support

IMPACTS ON STUDENTS' PROGRESS — As a result, in science students can increase:

- Engagement and confidence
- Awareness of strengths and weaknesses
- Independent learning skills
- Attainment

Figure 2 - Benefits of flipped learning, adapted from Straw *et al., (*2015)

1. Bergmann, J. and Sams, A. (2015). *Flipped learning for science instruction*. Oregon: International Society for Technology in Education.
2. Bloom, B.S. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. New York: David McKay Co Inc.
3. Covill, D. Patel, B. and Gill, D.S. (2013). Flipping the classroom to support learning: an overview of flipped classes from science, engineering and product design. *The School Science Review*, 95 (350), pp. 73-80.
4. Jarvis, W. Halvorson, W. Sadeque, S. and Johnston, S. (2014). A large class engagement (LCE) Model based on service-dominant logic (SDL) and flipped classrooms. *Educational Research and Perspectives*, 41, pp. 1-24.
5. Jdaitawi, M. (2020). Does Flipped Learning Promote Positive Emotions in Science Education? A Comparison between Traditional and Flipped Classroom Approaches. *Electronic Journal of e-Learning*, 18 (6), pp. 516-524.
6. Rudd, P. Aguilera, A.B.V. Elliott, L. and Chambers, B. (2017). *MathsFlip: Flipped Learning. Evaluation Report and Executive Summary*. Millbank: Education Endowment Foundation. [online] Available at: https://educationendowmentfoundation.org.uk/public/files/Projects/Evaluation_Reports/Flipped_Learning.pdf (Accessed 20 May 2021)
7. Say, F.S. and Yildirim, F.S. (2020). Flipped Classroom Implementation in Science Teaching. *International Online Journal of Education and Teaching*, 7 (2), pp. 606-620.
8. Straw, S. Quinlan, O. Harland, J. and Walker, M. (2015). *Flipped learning research report.* Berkshire: National Foundation for Educational Research (NFER) and Nesta. [online] Available at: https://www.nfer.ac.uk/media/2018/nesm01.pdf (Accessed 01 June 2021)

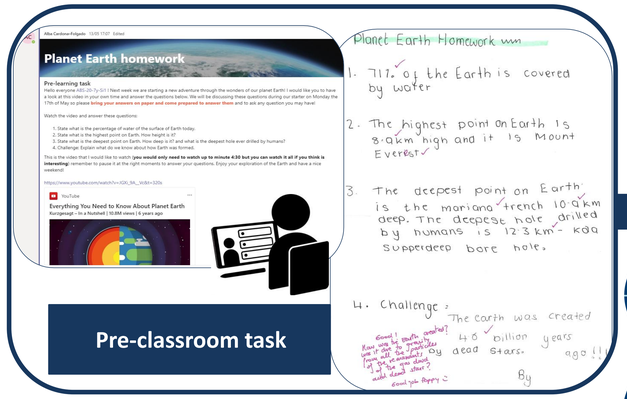
3 APPLY – How could it benefit my science classroom?

In science education flipped learning can allow for more hands-on lab time, more inquiry (e. g. PBL) and guided practice with the expert teacher.

The aim of this study is to test how flipped learning can benefit science by making more effective the use of classroom time with a year 7 group of higher ability (HA) students and a year 10 group of mixed ability students. Students from both classes were asked to complete an online task to learn the basic concepts prior to starting a new unit of work. During the lesson students were expected to engage in deeper learning by accessing higher order thinking skills.

- The year 7 students were assigned a pre-task at the start of the unit *Earth* which consisted of watching a video and a closed written task (Figure 3).
- The year 10 students were assigned a pre-task at the start of the unit *Ecosystems* which consisted of a video and an open question to reflect upon.

Figure 3 - Evidence of task set on Microsoft Teams for year 7 students and student's work with feedback.



4 ANALYSIS – Discussion on classroom practice

Results from year 10 classroom were unsuccessful:

- Only 40% of the students from year 10 class engaged with the pre-task. This limited the time during the classroom to the lower categories on Bloom's taxonomy (Bloom, 1956) (Figure 1).

Results from year 7 classroom were successful:

- Over 85% of the students from year 7 class engaged in the pre-task. Their level of understanding of the topic allowed for a deeper learning experience during the classroom time.

"Alba covered the knowledge quickly and went straight into unpicking that knowledge and focusing on the harder stuff. What really facilitated this was the excellent flipped homework. It's a great example of how students can learn foundational content on their own and be challenged more quickly"
Mr. Betts-Master – Head of science

Limitations of research: After the initial description of the approach given by Bergmann and Sams (2015) most references focus on defining the technique and its uses (Jarvis *et al.,* 2014), however, there is limited research to guide good practice amongst teachers. Jdaitawi (2020) noted how research in this area is mostly carried out at undergraduate level and in disciplines such as maths or medicine, which might not compare to how it can benefit younger students. Finally, generalisations from the literature should be done with caution as most studies cited in this work have used relatively small sample sizes.

5 EVALUATION – Reflections and links to effective practice

The comparison in outcomes might underline factors of effectiveness:

- ***What could have been improved with year 10 students?*** Several factors might have influenced the lower engagement: The lack of homework culture in year 10 students; or design of the pre-task - less explicit expectations. Considering students perspectives, they showed a lack of understanding of the learning value of the task.
- ***What went well with year 7 students?*** The positive outcomes obtained with year 7 class align to some of the benefits cited in the literature (Covill *et al.,* 2013). Factors such as a clearer activity with explicit expectations could have enabled success. Considering students lenses most students on year 7 claimed to find the activity "fun" as they had more time to access engaging collaborative learning tasks.
- ***What was the learning value?*** Considering the Bloom's 'taxonomy of educational objectives' (1956), students applied the low levels of cognitive work outside the class and accessed the higher orders of thinking in class (Figure 1). Linking to a social constructivist theory, flip learning enables students to become problem solvers and active learners, as well as enhancing interpersonal communication with others (Jarvis *et al.,* 2014). Thus, making an effective use of the classroom time in which the teacher is guiding the students to become metacognitive (Figure 4). As predicted from the work of Bergmann and Sams (2014) each students in my year 7 class moved at a flexible pace, therefore differentiation was successful. Rudd *et al.,* (2017) concluded that the outcomes outbalanced the costs in a flipped classroom, and from my practice I have observed how students' learning was enhanced, therefore highlighting the educational value of this teaching approach.

Figure 4 - Example of an effective flipped classroom simulating the outcomes with year 7 class in Abbeyfield school. Source: Adobe stock

6 CREATION – Questions raised and next steps

Flipped learning has the potential of being a very beneficial technique in science education, however, limitations and challenges must be considered.

How to design effective tasks? How to ensure engagement in the tasks?

- Access to technology should be considered
- Identification of appropriate resources
- Nurture a homework culture that can result in high level of engagement.
- Consider the ability to work independently of the students – Scaffolding
- Flexibility to this approach – teachers should reflect on how this method is working with each group.

Overall, the reflections over the application of this technique from my practice have been very valuable. Moving forward, I would like to consider flipped learning as one approach amongst a wide repertoire of teaching methods.