To what extent is the use of flipped learning in A level Biology suitable for students with lower prior attainment?

RESEARCH REPORT

To what extent is the use of flipped learning in A level Biology suitable for students with lower prior attainment?

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Abstract

Background and Purpose: Flipped learning has gained attention for its potential to enhance student engagement and learning by shifting content delivery outside the classroom and prioritising interactive activities during lessons. However, concerns remain about its suitability for students with lower prior attainment. This study examines the effectiveness of flipped learning in supporting such students within the context of A-level Biology at a co-educational sixth-form college in Somerset, United Kingdom.

Aims: The research aimed to evaluate whether flipped learning could enhance engagement and understanding for students with lower prior attainment.

Design or Methodology: Using Lesson Study as an investigative framework, teachers collaboratively planned, observed, and refined a flipped learning lesson on "Plant Responses." Students completed preparatory tasks, including structured textbook activities and watching videos, before engaging in interactive classroom activities. Case study students with the lowest prior attainment were observed, and feedback was collected through student feedback and teacher reflections.

Findings: Flipped learning positively impacted all students, including those with lower prior attainment. Teachers observed higher-quality questions, answers, and practical task engagement amongst all students compared to traditional lessons. Case Study students reported feeling more confident than usual due to the completed preparation work, which increased their willingness to participate in class discussions. Teachers valued the collaborative planning process, which led to the development of highly effective teaching resources and activities, although the increased preparation time was a notable challenge.

Conclusions, Value, and Implications: The study highlights flipped learning's potential to fostering deeper understanding and confidence amongst students with lower prior attainment, provided that preparatory tasks are well-structured and accountability is maintained. While effective, the model demands significant teacher preparation time, suggesting incremental implementation. Expanding this approach across a full module and scaling it to other disciplines could offer further insights.

Keywords: flipped learning, A-levels, biology, lower prior attainment, preparation work

Context

This intervention focused on the use of flipped learning in A level Biology in a co-educational sixth form college in Somerset. The college has circa 2000 students who follow a range of different programmes such as GCSEs, A levels and Vocational courses, Accountancy or Education Apprenticeships, and Adult Learning qualifications. The students who participated in this study were in the second year of their A level Biology study (age 17-18).

Motivation, focus and questions

The increasingly diverse needs and backgrounds of students in further education (FE) present both challenges and opportunities for practitioners. Addressing these demands requires more inclusive, personalised, and adaptive approaches to teaching and learning. The flipped classroom approach offers a potential solution here, giving students increased flexibility, allowing them to study at their own pace and enable teachers to make class time more interactive. However, a literature review by Aaron Taylor (2015) highlights several challenges associated with the flipped classroom model. He notes that its success relies heavily on students' motivation to complete preparatory work outside of class. Additionally, the creation, development, and implementation of flipped lessons can be labour-intensive for teachers who already face demanding schedules. Taylor also points out the potential technological barriers for teachers who opt to create their own video materials. This observation aligns with findings from Akçayır & Akçayır (2018), who reported that the primary challenges of flipped learning stem from out-of-class activities, particularly inadequate student preparation. Nonetheless, they also emphasized the model's benefits, including improved learning outcomes. In neither review was there any discussion about the relative benefit on different learners, or those of different prior achievement.

Trials of flipped learning within the Biology department at Richard huish College had shown advantages of its use to cut down the time involved in imparting information from a content heavy specification. However, teachers had the impression it particularly suited the more able students.

To explore these concerns, Lesson Study was chosen as an investigative framework. This method promotes collaboration among teachers by involving them in the planning, observation, and reflection of lessons, fostering greater collegiality (CfEM Lesson Study Toolkit, Section 1). Students with lower prior attainment were selected as case study participants, during the observation process to focus the investigation on this group's experience with flipped learning.

Given that the Lesson Study involved only a single planned lesson, repeated with a parallel class, measuring the impact was challenging. Teachers relied on their professional judgment, comparing the quality of learning to that observed in traditional lessons from previous years. This evaluation considered students' oral responses during the lesson, the quality of their written answers, and their ability to engage with a more complex practical planning task that would not typically fit within the time frame of a traditional lesson.

Observers also interviewed students, including the case study students, to gather feedback on their experience with flipped learning. Students were asked to reflect on how this approach influenced their learning compared to more traditional teaching methods. These qualitative insights, combined with teacher observations, helped assess the effectiveness of the flipped classroom model in addressing the needs of students with lower prior attainment

Inquiry plan and activities

The Lesson Study process began with an initial meeting to identify the research question. The focus was to explore whether flipped learning could be effectively used with students who had the lowest prior attainment. The team co-planned both the out-of-class preparation work and the in-class activities around the topic of Plant Responses from the OCR A-level Biology specification.

This topic was chosen because it is taught in the second year of the A-level course, where students are expected to have developed the self-motivation and skills necessary for completing preparatory tasks. Additionally, this topic historically had lower student engagement, with comments like "I don't like plants" or "plants are boring." It also involved a section of the curriculum that members of the Biology team admitted they had found challenging to teach in an engaging way.

The co-planning process, which was new to most participants, proved to be a vital part of the Lesson Study. Drawing on insights from the literature, the preparation tasks were carefully designed to avoid being overly burdensome or time-consuming. The tasks included specific, time-guided activities linked to relevant pages in the course textbook, supplemented by a few short, engaging video links, for instance, one video explained how plants defend against aphids by releasing pheromones that attract parasitic wasps. The team deliberately sourced existing videos from reputable sources to avoid the workload of having to record their own.

The tasks focused on topics such as how plants respond to stimuli like abiotic stress and herbivory, as well as the role of plant hormones in phototropism. Students were also tasked with completing the first two pages of their module booklet, a pre-existing resource developed by the Biology team. In previous years, when taught in a more traditional way, these pages in the module booklet would have been completed by the students during the lesson, with the teacher delivering and explaining the material.

The classroom activities were designed to build on this preparatory work and included paired and small-group discussions. Starter questions assessed students' understanding of the out-of-class tasks, using visual prompts to encourage application of their knowledge. For example, students were given an image of cress seedlings bend toward a window and another of a plant in a tipped-over pot growing upright against gravity and asked to explain these observations in scientific terms (see examples in appendix). Subsequent activities included a past exam question on the new material and a more complex task where students designed an experiment to investigate the tropic effects of light or gravity on plants. The team also prepared new resources, including PowerPoint slides, past exam questions, and discussion prompts.

The first cycle of lesson observation involved one teacher delivering the lesson while the other two observed. Internally developed Lesson Study templates were used to guide the observation process (see appendix). In advance, three case study students were identified—those with the lowest prior attainment in the class of 22. The class teacher selected these students, believing they might struggle most with the preparatory work and therefore face challenges during the lesson. These students, seated at different points in the room, did not work together and were unaware of their designation as case study students. Observers focused on these students during the lesson, monitoring their engagement and understanding while ensuring they only perceived the observation as general interest in the new teaching method (see appendices).

After the lesson, the triad met to discuss their observations and refine the lesson plan. The revised lesson was taught by another teacher the following week, with a different class of students,

with only minor adjustments needed. For example, some students completed the past exam question much faster than others, and so some additional extension work was needed to stretch the more able students further. After the second observation, the triad convened for a final meeting to summarize their findings and reflect on the process.

Ethical considerations and relationships

It is important to consider the dynamics and relationships within each classroom setting for flipped learning activities to be effective and for this progress to be measured effectively. We trialled the flipped learning strategies in two classes of Year 2 Biology students. The teachers facilitating these sessions were aware of all SEND students' needs and were able to provide reasonable adjustments to these classes to enable each student to actively engage in both the preparation tasks and the discussion tasks being administered.

As biology is a large department, each teacher has a range of classes from the year group studied, so it would be difficult to identify individual groups within this study and no student names were used as part of the processes. Case students were referred to by initials between researchers, which have been redacted from this report.

All students in the lessons had been informed that the Biology department was wanting to conduct research into a new method of teaching this topic. They were asked if they were happy to participate, and it was explained that their learning would be observed by some other members of the Biology department, and their opinions would be sought as to whether they found this new method helpful or not, in order to try to improve the learning of students in future lessons.

As the hypothesis was that flipped learning would enhance student engagement and learning of the topic being taught it was important to give all groups the chance to have their learning enhanced. Therefore, any classes which weren't involved in the observed lessons still had the same resources and teaching strategies used when covering the same topic in their lessons.

Findings

We discovered that in both lessons the Case Study students with lower prior attainment coped well with both the preparation work and with all class activities. When questioned, a couple of them said they preferred the flipped learning style as it gave them chance to read ahead and familiarise themselves with the material, and so they were more confident than usual to contribute in class and felt more able to apply their knowledge to the exam questions.

Feedback from the staff involved in the process was positive too:

> "Co-planning the lesson was my favourite part of the Lesson Study and something I would like to do more of. I found I was more ambitious of what my students could achieve."

> "As we had jointly planned it, I hadn't felt under any pressure to 'perform' during the observation. We were all collectively responsible for its success or failure."

As the process only involved one lesson, delivered on a repeated cycle, there was no measurable impact, however, anecdotal evidence from all teachers involved was that student engagement in the topic was significantly improved and that the quality of learning was also improved.

This was judged by the quality of the paired and group discussion when answering the initial discussion questions and the level of understanding displayed in answering the past exam question. The final activity of planning an experiment to investigate the effect of gravity on plants was a challenging one, and yet students readily engaged in this task, feeling confident of their understanding of the previous learnt theory. This task typically would not have been attempted within the lesson's time frame using traditional teaching methods, suggesting that the students were prepared to tackle more challenging material sooner.

During the observation, the teacher directed questions to some of the Case Study students and remarked that both their willingness to answer, and the quality of their answers was greater than it was normally.

Changes to practice

Through the Lesson Study process, we observed the impact of flipped learning on the students we had been concerned about, which reassured everyone involved. The collaborative nature of the planning exercise also boosted all staff members' confidence in implementing flipped learning. As a result, it was agreed that flipped learning would be incorporated into the Scheme of Work moving forward.

Additionally, we ensured that all classes not directly involved in the observed lessons used the same resources and teaching strategies for the same topics. This allowed us to assess the impact of the new teaching method across five additional classes. Teachers reported very high completion rates for the preparatory work, as well as increased student engagement with the subject matter and enhanced learning during lessons.

Overall, while the lessons were successful, it is too early to conclude that adopting flipped learning as a long-term strategy would yield the same results.

Reflective evaluation on the process

One of the most successful elements of the study was the co-planning phase, which led to the development of highly effective teaching resources and activities. All staff members involved noted a marked increase in student engagement and a deeper understanding of the material when using flipped learning compared to traditional delivery methods. Importantly, this improvement was also evident in the case study students, who had the lowest prior attainment scores in their respective classes.

A challenge in assessing the impact of flipped learning was the reliance on teachers' professional judgment. Their evaluations were based on their prior experience teaching the material traditionally. They considered the quality of students' questions and answers during the lesson to identify potential improvements in learning outcomes. Previously, a significant portion of the lesson was spent delivering content, leaving less time for answering exam questions and correcting misconceptions. With flipped learning, teachers felt they could better gauge student understanding and address misunderstandings earlier, as more lesson time was devoted to application and discussion.

Observers also gathered feedback directly from the case study students. Rather than being disadvantaged, these students reported that the flipped approach benefited them significantly. They found the preparatory work enhanced their understanding and gave them greater confidence to contribute during class discussions. Notably, all students in the observed classes completed the preparation tasks, which was attributed to clear expectations set by the teachers. The tasks were manageable in both time and complexity, and the consequences of not completing them—being

unable to fully participate in class—were made explicit. Moving forward, maintaining this balance of rigour, clarity, and accountability will be critical for the success of flipped learning.

Collaboration among the teaching team was essential for the project's success. The group's similar levels of subject knowledge and teaching experience allowed for supportive and non-judgmental observations. This created an environment where strengths and weaknesses could be openly discussed, enabling reflective practice and meaningful dialogue about meeting diverse student needs. However, scheduling time for discussions, evaluations, and planning often felt rushed, which occasionally hindered deeper analysis. Despite this, the process fostered valuable insights into how flipped learning could effectively support all learners.

The preparatory work for students was deliberately kept achievable and clearly defined, with tasks linked to specific textbook pages. In-class activities built on this foundation through differentiated tasks, ensuring that even the most able students remained challenged and engaged. However, this approach demands significant preparation time from teachers.

If the study were to be repeated, expanding it to cover an entire module would provide a clearer picture of how student learning evolves over time as they become more adept at the flipped model. This longer timeframe would also facilitate more reliable outcome measurements. Scaling the study across different disciplines and age groups could further assess whether flipped learning benefits students with lower prior attainment as effectively on a larger scale as it did in this small-scale study.

While most students expressed positive attitudes toward the flipped learning approach, some were hesitant about its exclusive use. They felt the continuous preparation work could become overwhelming and reduce their enthusiasm for the method. These students appreciated the novelty of the flipped classroom but suggested it might be better suited as a supplementary teaching strategy rather than a universal approach.

Next steps

The potential for flipped learning as a teaching tool within Biology is significant now that initial fears about it disadvantaging students with a lower prior attainment have been dispelled. Co-planning of these lessons also proved helpful and it would be sensible to enable this to happen on a wider scale. The implication for teacher time in planning is not insignificant however, and therefore it may be more appropriate to implement it on an incremental basis only.

References

Akçayır & Akçayır (2018) The flipped classroom: A review of its advantages and challenges

CfEM Lesson Study Toolkit, Section 1, CfEM-lesson-study-toolkit-section-1.pdf (et-foundation.co.uk)

Taylor, A. (2015) 'Flipping great or flipping useless? a review of the flipped classroom experiment at Coventry University London Campus' Journal of Pedagogic Development 5 (3)

About Camtree

Appendix 1: Lesson Study Pre-Planning Template

Confirm your team (ideally between 3-5 people)	Names removed.
Set ground rules for assessed risk taking & joint ownership of the research lesson/s.	*We are engaging in joint professional learning and therefore agree to:* ✓ *Take risks & accept that ideas will fail as well as succeed.* ✓ *Ensure learning benefits students & colleagues)*
Identifying your Research Focus	**Possible research question** *We want to find out how we can get better at* understanding the impact of flipped learning *on students with lower prior attainment in order to decide whether to implement this method more widely across the department.*
Logistics As a group identify possible classes that you want to focus on and at what point in your scheme of work / term it will be best to carry out your lesson study. You could start to think about who might take on what roles at different stages or cycles of the process (e.g. who will teach the first lesson / who will observe...)	Year 2 Biology classes. Students have more mature and well established work ethic and more likely all will complete the preparation work. Topic: Plant Responses - Introductory section looking at abiotic stress, herbivory + leading on to phototropism. First lesson to be taught by [redacted] and others in the Lesson Study group will observe. This group is currently ahead of other groups, so will allow time for reflection before lesson taught to parallel group by [redacted]

What do we already know? In your group consider what your current knowledge base and skills are in this area / what you know to be good practice / effective techniques and make a note of them. **What research are you reading to add to your existing knowledge?** Are there articles, books, blogs, podcasts you could use to add to your current knowledge and understanding?	Trials of flipped learning so far quite successful but only used by some members of the teaching team. Importance of clear instructions for preparation material, not too onerous – need to be well within capabilities of all students. Recording videos very time-consuming. Use of pre-existing videos would save time. Worth thinking in advance about what to do with any students who don't do the work? Is there somewhere we can send them to complete it whilst the lesson takes place? We have looked at 'What is Flipped Learning?' : Flipped Learning Network (FLN). (2014) The Four Pillars of F-L-I-P™ FLIP_handout_FNL_Web.pdf and had spoken to colleagues more familiar with the flipped approach. Know importance of maximising class time to demonstrate benefit of this learning method.
How do you intend to Involve students in your research?	We will inform them that we are trying a flipped approach and will seek their feedback on how they find it compared to more traditional teaching methods.

Appendix 2: Planning Template

Intended Professional Learning
(Describe what you as teachers want to learn more about as a result of conducting this research lesson). We want to evaluate whether flipped learning could enhance engagement and understanding for students with lower prior attainment.

Intended Student Learning	
(summarise the key curricular as well as other learning which is designed to happen in this lesson. The other learning may relate to ideas you are developing, social, attitudinal or behavioural learning or meta-cognitive / other cognitive processes)	
Curriculum / subject learning intention(s) for students	*Other learning / development intention(s) – social, linguistic or meta-cognitive (for students)*
PLANT RESPONSES (i) the types of plant responses (ii) practical investigations into phototropism and geotropism Plant response to abiotic stress and herbivory. Herbivory response to include chemical defences (alkaloids and pheromones only) and folding in response to touch **AND** the range of tropisms in plants. practical investigations into the effect of plant hormones on growth	Social, oracy, ability to apply knowledge to unfamiliar contexts, Ability to plan experiments

Case students – Summary of Learning Needs			
Identify the case students whose learning you will be focusing on for this research lesson			
Name	One	Two	Three
Why chosen for focus	*Student 1* *Low prior attainment*	Student 2 *Low prior attainment*	Student 3 *Low prior attainment*
Level of operation in this area (e.g. grades for recent work...)	D / E	D	E
What outcomes you are hoping for from this student (e.g. to be able to...)	Complete all tasks and contribute to paired and group discussion	Complete all tasks and contribute to paired and group discussion	Complete all tasks and contribute to paired and group discussion

Appendix 3: Lesson Plan

Research focus:	We want to learn whether students with lower prior attainment can equally benefit from a flipped learning model.
What we want them to learn:	**PLANT RESPONSES** (a) (i) the types of plant responses (ii) practical investigations into phototropism and geotropism Plant response to abiotic stress and herbivory. Herbivory response to include chemical defences (alkaloids and pheromones only) and folding in response to touch **AND** the range of tropisms in plants. (e) practical investigations into the effect of plant hormones on growth
Activities / sequence of lesson	(10 mins) Starter activity Paired discussion with mini white boards to answer starter questions (PowerPoint slide 2). This will demonstrate how well they have completed the preparation work. (10 mins) Feedback: Class Q & A. Clarify any misunderstandings from preparation work evident in students' answers. Link answers to info on pre-recorded videos in preparation work. (10 mins) Past exam Question – students work through in pairs on mini white boards and discuss scenarios of plants in different conditions. (PowerPoint slide 2) (10 mins) Go through past exam question. Q& A. Explain Mark scheme and focus on detail in answer and required marking points. (5 mins) Launch practical planning task. Explain Clinometer and scaffolded practical planning sheet. (PowerPoint slide 3) (25 mins) In pairs, students chose to plan an investigation on either the effect of light intensity, or the effect of gravity on the growth of a plant. They need to consider all the factors in the scaffolded sheet e.g. IV, DV, controlled variables, validity, what they will measure, sample size etc. (Handout sheet) Teacher to circulate and give assistance as required. Students to stick plan in their lab books as evidence of PAG 12: Planning activity.

Appendix 4: Post-Observation Discussion Sheet

Research focus: We want to learn whether students with lower prior attainment can equally benefit from a flipped learning model.

What we wanted them to learn:

PLANT RESPONSES

(a) (i) the types of plant responses
(ii) practical investigations into phototropism and geotropism
Plant response to abiotic stress and herbivory. Herbivory response to include chemical defences (alkaloids and pheromones only) and folding in response to touch
AND
the range of tropisms in plants.
(e) practical investigations into the effect of plant hormones on growth

	Whole Class	**Case Students**
Were the subject learning objectives achieved?	Yes	Yes
What progress did students make?	All students were engaged with the paired and whole class discussions. They were able to articulate answers to the starter questions and the past exam question. They were also able to complete a more challenging planning task to investigate the effect of light or gravity on plant growth.	The three observed case study students also engaged with the paired and whole class discussions. They were able to articulate answers to the starter questions and the past exam question. They were also able to contribute to the more challenging planning task to investigate the effect of light or gravity on plant growth.
Were they aware of their achievements?	Yes	Yes

Were they clear on how to overcome difficulties?	Yes, they could ask the teacher for help in the planning task if stuck on e.g. suitable species of plant, how to measure the angle of bend etc.	Yes, they could ask the teacher for help in the planning task if stuck on e.g. suitable species of plant, how to measure the angle of bend etc.
Were they motivated / engaged?	Yes, very much so.	Yes, very much so.
What worked really well?	A good sense of student engagement and enjoyment on a topic that often had previously been met with groans.	These students readily contributed to whole class discussion, more so than they would normally. When asked by the observers on how they were finding the lesson they said they felt more confident than normal due to the preparation tasks.
What problems arose?	A couple of the more able students completed the planning task whilst other pairs were still at the early stages. They therefore needed to have more extension material available.	. None observed.
What would we change next time or if we did this again?	Have an additional extension activity available for the more able students.	

Appendix 5: Slides from PowerPoint presentation including preparation work and class activities

PLANT RESPONSES

Preparatory work:

- Read pages 377 - 379 in your CGP book
- watch these videos:
- https://www.khanacademy.org/science/biology/plant-biology/plant-responses-to-light-cues/v/phototropism (6 mins)
- https://www.youtube.com/watch?v=rLtUk-W5Gpk A plant response to herbivory (2 mins) - warning: pretty gruesome!
- https://www.youtube.com/watch?v=BLTcVNyOhUc *Mimosa peduca* (watch about 30 seconds)
- Use all this information to **complete page 2 and 3 of your module booklet.**

- **This MUST be completed before your lesson, or you won't be able to take part in the lesson.**

Starter Questions – in pairs on mini white boards

- 1. What is meant by the term abiotic stress?
- 2. Give an example of a plant response to herbivory
- 3. What parts of a plant produce growth hormones?
- 4. Explain what is occurring in these images, using as much scientific detail as you can.

Plant Tropisms - Phototropism, Thigmotropism, and More (thoughtco.com)

Gravitropism (geotropism) - Stock Image - C028/7030 - Science Photo Library

2 Scientists took three Goosegrass seedlings and planted them in individual pots with soil taken from the same source. They let each seedling grow for 15 days in the conditions shown in **Fig. 2.1**.

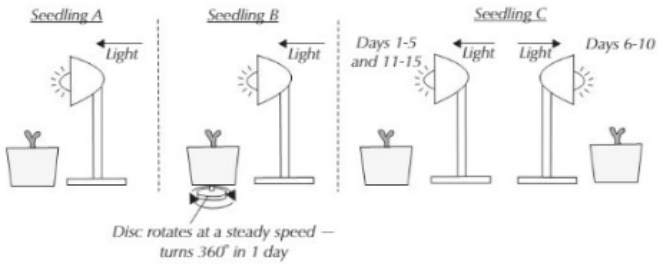

Fig. 2.1

(a) Suggest what response the scientists were testing with this experiment.

(1 mark)

(b) The scientists didn't include a control in their experiment. Describe the conditions that should have been used for a seedling acting as a control.

(2 marks)

(c) Suggest why the scientists used soil taken from the same source for all the seedlings.

(1 mark)

(d) Describe and explain the pattern of growth in the three plants that you would expect to see by the end of the experiment.

(3 marks)

(e) Explain the role of growth hormones in controlling the direction of growth in this experiment.

(3 marks)

Planning experiments - A key skill tested in exam papers. This topic lends itself well to this type of question.

- **In pairs, discuss how you could design an experiment to investigate the tropic effect of light, or gravity on plants.**
- There are key points you always need to consider when designing an experiment. Use the prompt sheet to help you.
- Time allowed: 20 mins

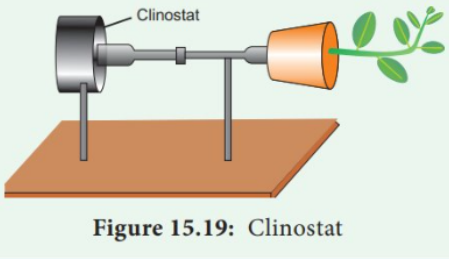

Figure 15.19: Clinostat

Hint: A clinostat is a device which uses rotation to negate the effects of gravitational pull on plants

Appendix 6: Student Handout

Planning an investigation on the effect of _____ on cress seedlings.

Independent variable	
Dependent variable	
Controlled variables And how they will be controlled	
Method (brief) including sample size and time period	
Do you need a control?	
What will you measure	
How will you analyse results?	
Risk assessment?	
How will you ensure validity of your results?	