

Acomb, Jonathan C. (2017) What are students' opinions of 'Flipped learning' in secondary science? The STeP Journal (Student Teacher Perspectives), 4 (4). pp. 9-18.

Downloaded from: <http://insight.cumbria.ac.uk/id/eprint/3400/>

Usage of any items from the University of Cumbria's institutional repository 'Insight' must conform to the following fair usage guidelines.

Any item and its associated metadata held in the University of Cumbria's institutional repository Insight (unless stated otherwise on the metadata record) may be copied, displayed or performed, and stored in line with the JISC fair dealing guidelines (available [here](#)) for educational and not-for-profit activities

provided that

- the authors, title and full bibliographic details of the item are cited clearly when any part of the work is referred to verbally or in the written form
 - a hyperlink/URL to the original Insight record of that item is included in any citations of the work
- the content is not changed in any way
- all files required for usage of the item are kept together with the main item file.

You may not

- sell any part of an item
- refer to any part of an item without citation
- amend any item or contextualise it in a way that will impugn the creator's reputation
- remove or alter the copyright statement on an item.

The full policy can be found [here](#).

Alternatively contact the University of Cumbria Repository Editor by emailing insight@cumbria.ac.uk.

What are students' opinions of 'Flipped learning' in secondary science?

The STeP Journal
Student Teacher Perspectives
Copyright © 2017
University of Cumbria
Vol 4 (4) pages 9-18

Jonathan C. Acomb
University of Manchester

Abstract

Flipped learning has emerged in recent years as an alternative method of teaching. The premise of Flipped learning is that students learn new material at home, and then use lesson time to tackle problems and interact with the subject matter. The rationale behind this is that students get more time with a teacher when they are solving problems or applying knowledge in the classroom, so teachers can help build higher levels of understanding. It also allows the lesson to be more interactive, as less time is spent teaching new material. Whilst many recent studies have concentrated on how Flipped learning is used at university level teaching, I was eager to undertake my enquiry on Flipped learning at secondary school. Having spoken at length to teachers about their opinions on Flipped learning, I was keen to discover what students' opinions were. This enquiry made use of a questionnaire, and interview with sixth form biology students at an all-girls grammar school who are taught via Flipped learning. Student opinions were largely positive, with students expressing being able to learn at their own pace, more interactive lessons and being better prepared for lesson time among the benefits of Flipped learning.

Introduction

In recent years there has been a large push to make lesson time more active for students so classrooms are more student-centred (Kurbanoğlu and Akkoyunlu 2017). This is so that students remain more engaged in lessons. This mirrors my own experiences and opinions that student engagement increases when more active teaching is used. One way that teachers have aimed to make classroom time more active and interactive for students is by so called 'Flipped learning'. In its simplest terms this can be thought of as doing '*school work at home, and homework at school*' (Flipped learning network 2017). However, it is important to characterise in more detail what Flipped learning is. The Flipped learning network define it as where '*direct instruction moves from the group learning space to the individual learning space*' so students learn subject matter individually at home. In class time the teacher then '*guides students as they apply concepts and engage creatively in the subject matter*'. This varies from conventional teaching, where class time is largely used to teach new material, and homework tasks are used to apply concepts they have learnt. In Flipped learning, these two processes are Flipped and so leaves more class time being more active, and allows the teacher time to go around the class and interact individually with students that require help. Herraïd and Schiller (2013) reason that Flipped learning works as essay writing and problem solving can be done more effectively with a teacher to guide students. This stands to reason as a teacher can interact and teach more effectively one on one. In a recent review,

Kurbanoğlu and B. Akkoyunlu (2017) defined Flipped learning as a form of teaching where students learn new material '*outside of class, and then the class time is used to apply the knowledge acquired*' usually in the form of '*problem solving and discussion.*' They state that the learning outside the classroom normally takes place in the form of online videos. Talbert (2017) however argues that Flipped learning need not include videos. Other alternatives can include reading and interacting with text, audio or simulations. I agree more with Talbert that Flipped learning need not need include

Citation

Acomb, J.C. (2017) What are students' opinions of 'flipped learning' in secondary science?, *The STeP Journal*, 4(4), pp. 9-18.

videos, as my own experiences of Flipped learning observing lessons showed that teachers can also make use of reading and annotating exercises for homework.

Literature review

The rationale behind Flipped learning stems from a number of perceived benefits that it brings. Bergmann and Sams (2009) were amongst the first to come up with the idea of Flipped learning. In their work they started making pre-recorded video and audio recordings of their chemistry lessons for their secondary school students in Colorado. Originally the reasoning was that absent students could catch up. However, they soon found it to be an effective way of teaching. In agreement with Herraïd and Schiller (2013) it was thought that students do not need the physical presence of a teacher during instruction, only during problem solving and enquiry. Bergmann and Sams (2009) also stated that in order for Flipped learning to be successful, a way of ensuring the students watched the lecture videos was needed. This stands to reason, as otherwise students who have not watched the videos would not have enough understanding to undertake the class activities. As a result, a way of checking who had accessed the videos was devised. Qualitative results from interviews with students argued that one of the benefits of Flipped learning is that it allowed students to learn at their own pace, as they could pause videos. Whilst this is specific to videos, other methods of teaching such as reading and interacting with text would also allow students to re-read and learn at a pace that suited them. From their own experiences, Bergmann and Sams (2009) also stated that another benefit of Flipped learning is that moving instruction to homework gave them more time to interact and get to know students better. This enabled them to tailor their teaching to individual, or small groups of students, allowing for differentiation. My own experience observing Flipped learning also showed that it allows for differentiation, as the teacher can prepare different activities and give different amounts of support where needed. In terms of academic performance of Flipped learning when compared to conventional methods, similar results were obtained when utilising Flipped learning. Whilst no improvement was observed, it stated that the results obtained with Flipped learning were with a group of lower academic ability. The class was judged to be of a lower ability, as they received lower marks on a similar test to the previous year group in a control test beforehand. As such, Flipped learning may have a small impact on achievement.

De Araujo, Otten and Birisci (2017) undertook a study on Flipped learning and obtained qualitative results on the experiences of two secondary maths teachers from the United States. Like Bergmann and Sams (2009), the teachers interviewed expressed the opinion that using Flipped learning gave them more time to work with individual students or groups of students directly. It was likewise thought that this allowed teachers the opportunity for individualised instruction. The authors argue that one of the main benefits of Flipped learning was that students became more engaged with the content. This was thought to be because more collaboration amongst students took place in the classroom. This stemmed from the fact that class time was given to activities rather than the students becoming disengaged whilst the teacher spoke at the front of the class. It was also thought that the students were more willing to contribute in class, as they were more prepared in lesson time, having already watched videos of lectures at home. Unlike, Bergmann and Sams (2009), De Araujo, Otten and Birisci (2017) presented their opinions on some of the drawbacks of Flipped learning. The teachers interviewed said that switching to Flipped learning led to an increased workload, as they had to spend a lot of time planning and making their videos. However, as this was expressed by a teacher who was new to implementing Flipped learning, it could be argued that once the resources have been made and modified over a number of years, less new material would need to be made. Likewise, as argued by Talbert (2017), not all Flipped learning has to be undertaken by making videos. As such much of the time making videos could be avoided. In fact, one of the teachers from the study did make use of guided notes to complete whilst reading a text book. Another challenge associated with Flipped learning identified in the study included the fact that they found it difficult to ensure the students watch the videos of lectures they needed to be able to participate in class. This stems from the fact

that not all students will be motivated to learn. As such, in my opinion, I agree with De Araujo, Otten and Birisci that this is a drawback of Flipped learning, and that it therefore may not be appropriate for all classes. The teachers also felt that a drawback was students who did not have access to IT or the internet. Whilst, some of this could be addressed by making use of reading, or books in place of videos, it would restrict the types of activity set for learning at home.

Whilst De Araujo, Otten and Birisci (2017) stated that increased teacher workload was a drawback of Flipped learning, Roehl, Reddy and Shannon (2013) argue that Flipped learning could result in less effort preparing lectures, and so leave more time to prepare in class activities. This suggests that rather than increasing preparation time, it may be reduced. This was backed up by a study by Lage, Platt and Treglia (2000) who found that preparation time was significantly reduced. However, this study was on implementing Flipped learning on a university course, and so the validity of whether this could be directly compared with secondary teaching could be brought into question. As yet I do not have experience of teaching flipped learning, and so it remains to be seen what my experience will be in terms of preparation time. My opinion however is that whilst it may require less time for preparation for instruction, preparation of more activities will compensate for this. Roehl, Reddy and Shannon (2013) also argue that Flipped learning increases engagement in lesson time. As with De Araujo, Otten and Birisci (2017) and Bergmann and Sams (2009), this is attributed to an increase in active learning amongst students. This mirrors my own experiences and opinions that active learning increases engagement. The study also agrees with others that a benefit of Flipped learning is that it can allow students to replay lectures and learn at their own pace. They go on to also argue that the range of methods that Flipped learning allows for instruction, such as videos, audio or websites allows for good communication to a wide range of abilities. Likewise the study agrees with that of De Araujo, Otten and Birisci (2017) that one of the drawbacks of Flipped learning is that students have to assume responsibility for their learning, and possess self-direction and a motivation to learn. As such, they argue that Flipped learning may not be effective for all classes. From my own experiences, Flipped learning was only utilised as a teaching style with sixth form at the school I taught at. This was because it was thought that only sixth form students had the required skills for self-directed learning and sufficient motivation. In this sense, my own experiences agree with what is written in literature.

In addition to what teachers' think of Flipped learning, student opinion is also an important consideration as a student may favour a certain style of learning, or become more motivated to learn. In addition to looking at student performance, Clark (2015) looked at how students viewed Flipped learning, and how engaging it made the lessons. It was undertaken with a class of secondary maths students from the United States. Both qualitative and quantitative results from students showed that Flipped learning led to an increase in student engagement and desire to learn. In accordance with opinions of teachers, the students felt this was because of an increase in interaction between students. Likewise, students also thought that Flipped learning provided an opportunity for improvement in communication between students and students, and students and teachers. The study however had the drawback of being fairly limited, as it was only carried out with one teacher. Comparing with different teachers or a wider range of participants would have helped to improve its validity. The study's relevance to my own future practice could also be called into question, as the subject the study was undertaken with was mathematics as opposed to science. Whilst the subjects do have similarities, there are differences in the skills and knowledge required. Similarly to Bergmann and Sams (2009), Clark also found there was no dramatic increase in attainment. However, whilst Bergmann and Sams (2009) saw no direct increase in attainment they argued that it increased the performance of a lower ability group. Clark saw no significant increase in attainment. A further limitation of Clark's Study is that Flipped learning was only undertaken over seven weeks, as opposed to a whole year in the case of Bergmann and Sams (2009). This may not have left enough time to obtain valid results, and may not have given enough time for students to get used to a new way of learning. In contrast to Clark's study (2015), He et al. (2016) found that compared to traditional

teaching methods, results in chemistry increased, albeit slightly, when Flipped learning was used. Whilst this does seem to agree more with Bergmann and Sams (2009) findings, it was undertaken with students at university level, and so again direct comparison may not be possible. Differences in student ability range and motivation and maturity could be different between the two studies.

I chose to undertake my enquiry on Flipped learning because, as I am going into a sixth form teaching job, I am eager to see what pupils think about it as a teaching method. The opportunity Flipped learning offers to make lessons engaging, and provide differentiation makes it very appealing as a technique.

Research Questions

Whilst some previous research on Flipped learning has concentrated on teaching at university (Lage, Platt and Treglia 2000, He et al. 2016), I was eager to find out how Flipped learning could be used at sixth form. From my own experiences, I have spoken to teachers about their views on Flipped learning and have undertaken CPD on the topic. This has given me a good understanding of what we as teachers think the benefits of Flipped learning are. However, teaching is at its essence all about pupils, and so I was keen to find out more about students' opinion of Flipped learning. The school I have been at for placement one and three introduced Flipped learning as a way of teaching in sixth form biology a few years ago, and so I decided to focus my enquiry on students' opinions were of their Flipped learning experience. As such, the main question of this enquiry is 'What are student's opinions of 'Flipped learning' in secondary science.' As I will be moving to a job in a sixth form college, I hope to use the results of this enquiry to influence my future teaching, so I can tailor my lessons to what students' needs are, based on their opinions of Flipped learning. Previous literature on Flipped learning has highlighted engagement (Roehl, Reddy and Shannon 2013), students being able to learn at their own pace (Bergmann and Sams 2009) and interactions between different students (De Araujo, Otten and Birisci 2017) and between students and the teacher (De Araujo, Otten and Birisci 2017) as being some of the key benefits. As a result, I decided to focus my study on questions on these aspects.

The context of the school where the enquiry was undertaken was an all-girls grammar school in England. The study included a questionnaire, obtaining qualitative and quantitative data about students' opinions on Flipped learning, as well as an in-depth interview with students. The questionnaire was given to sixth form students who have studied biology at A level, where Flipped learning is used. It was given out to four different classes across year 12 and 13 with a total of 21 responses received. The first section of the questionnaire included 8 statements, which students then had to indicate whether they strongly agreed, agreed, disagreed or strongly disagreed with. Four options were purposefully chosen, so that students had to indicate one way or the other whether they agreed, and could not go for 'middle option'. The second section of the questionnaire aimed to get more qualitative data, by asking more open questions on students' opinions on the benefits and drawbacks of the way they are taught. The results of the qualitative data were then looked at thematically, to identify trends or recurring opinions or viewpoints. An interview was also undertaken with two year 13 students, to try and probe their opinions further, and understand their reasoning. The interview was conducted after obtaining results from the questionnaire, so that the themes that evolved could be investigated in more detail.

The majority of the students are not aware of the term 'Flipped learning', and so my research questionnaire had to ensure that it did not refer to this directly. As a result, the questions compared the way they are taught in biology at A level, where they undertake Flipped learning, to teaching at GCSE or other subjects, where traditional styles of teaching are undertaken. To make sure the students were aware of what was being asked, I included a short paragraph setting a context.

Results

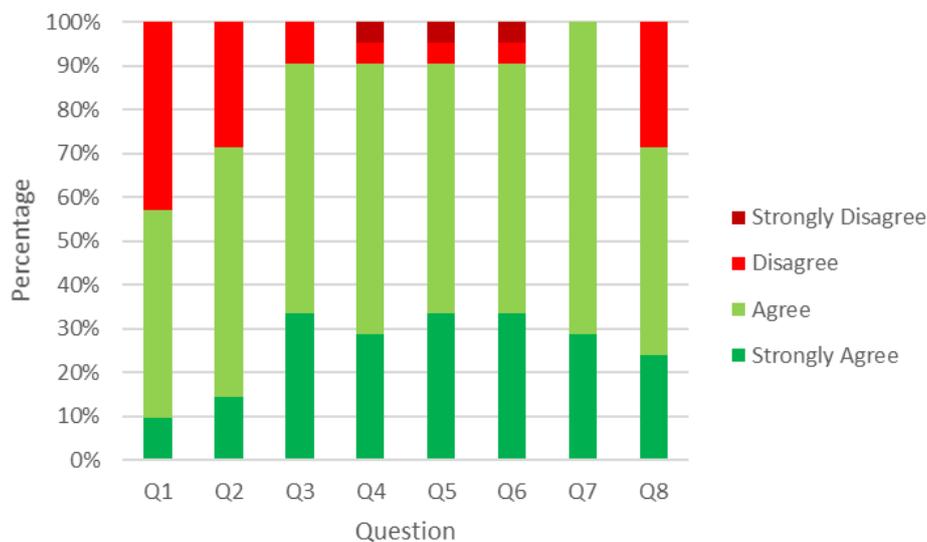


Figure 1: Responses from questionnaire

Student responses for section A of the questionnaire were analysed in terms of the number that agreed or disagreed with the statements. Figure 1 shows the responses from the questionnaire for questions 1 to 8.

Table 1 in the next section shows the main themes that emerged from each of the interview questions. As can be seen from the table, a number of these were recurring themes across all the questions. To understand the trends further, an interview was then undertaken with two students. The interview involved open questions, so as not to lead students towards an answer so that the results were reflective of the students' true opinions.

Analysis and discussion

The results from section A of the questionnaire indicate that the students overall have a positive view of Flipped learning. This can be seen by the fact that the modal response for each of the questions 1 to 8 was 'agree'. When the results are broken down into number of pupils who strongly agree, agree, disagree and strongly disagree, more students agreed or strongly agreed with questions 3, 4, 5, 6 and 7 compared to questions 1, 2 and 8. Questions 1 and 2 are related to how much students interact with the teacher or other pupils compared with other teaching methods. The fact that more students disagree with this suggests that some students did not think that there was a great deal of interaction in the lessons. Question 8 is related to whether or not pupils prefer Flipped learning to other methods. Some students clearly felt that they preferred other styles of teaching to Flipped learning. Based on responses from Section B of the questionnaire, it is possibly to do with the fact that they do not like independent learning styles. In their study, Roehl, Reddy and Shannon (2013) likewise thought that Flipped learning is not suitable for all students, as not all students have the motivation and self-directed learning skills required.

In order to analyse the results in more depth, the results will be looked at in terms of the themes that arose from the responses to the questionnaire, and the interview. These will be looked at in terms of what the students thought were the benefits and drawbacks of Flipped learning.

Table 1. Themes emerging from questionnaire.

Question number	Question	Themes emerging from questions						
		Being prepared for lesson time	Working at home	Pace of learning	Interactive lessons	Independence	Interaction with teacher	Interaction with other students
1	What benefits do you get from learning new material at home?							
2	What do you think are the advantages of the way you are taught in A level biology?							
3	What do you think are the disadvantages of the way you are taught in A level biology?							
4	In relation to a typical A level biology lesson, what do you enjoy most about lesson time?							
5	In relation to a typical A level biology lesson, what do you find most beneficial about lesson time?							

Being prepared for the lesson

One of the main findings from the student responses, was that they valued the opportunity to work at home, as it made them better prepared for lesson time. Some felt that pre-reading allowed them to “*Get through content quicker*” once they came to class, and that they enjoyed “*Doing questions once I understand the material*”. De Araujo, Otten and Birisci (2017) also found that students felt more prepared, and were more willing to contribute in class. In relation to science, one of the major difficulties can be the language used (Wellington and Osbourne 2001). In the interview, the students made a point of mentioning language and new terms; the fact that they had learnt at home before the lesson meant they had already “*heard some of the words, it’s not completely new to you so it’s easier to pick up.*” This suggests that they feel one of the benefits of Flipped learning is that students

can interact with language before the lesson. In terms of my own future practice, I feel that giving students pre-reading for homework could be effective even if I do not fully implement Flipped learning. I see it being beneficial for students who may not have English as a first language because it provides the opportunity to work on literacy and familiarise them with some of the terms involved.

On the flip side, students also felt that they struggled in the lesson if they did not understand the pre-reading from the work at home. This was highlighted as one of the disadvantages of Flipped learning with students saying *"lessons can be confusing"* or that they are *"behind in the lesson"* if they struggle with the learning at home.

Working at home and pace of learning

One of the major benefits of Flipped learning that students agreed with in section A of the questionnaire was that learning new material at home was beneficial and that it allowed them to work at their own pace. This was also identified as a benefit by Roehl, Reddy and Shannon (2013). The qualitative data from the questionnaire, also show that students value the fact that they can learn at their own pace. In response to the benefits to working at home, one student wrote that *"I can take more time to research the material at home so I can understand more easily"*, clearly showing that they benefit from the extra time they are able spend when learning at home in their own time. The element of having control over how and when they learn was also a common theme in the interview. One of the students in the interview stated they *"prefer doing stuff at home, because I'm in control over what I can do"*.

Not all students felt that learning new material at home was without problems. Some students felt there was not enough variety in the ways that they learn new material at home, and that much of it is *"just reading from the textbook which is a bit boring."* This indicates that a larger variety of activities could help students become more engaged whilst learning at home. However, having spoken to teachers at the school, they said the reason for not using the internet activities such as videos as often was because they do not want to set anything that will exclude students who do not have access to the internet. For my own future practice, it may be beneficial to use a range of activities including videos or animations on the internet, however this would only be feasible if all the students had access to the internet, either at home or in the school.

Interactive lessons, and interaction with other students

Figure 1 shows that for question 7, relating to whether the lesson time was interactive, all students either agreed or strongly agreed with this. This was also one of the main themes that was brought to light in section B of the questionnaire, with students bringing it up in relation to what they thought the main benefits of how they were taught, and what they enjoyed about lesson time. One response stated that they enjoyed *"the fact that we can do group work so we can see what other people are struggling with and help them if necessary"*. The students interviewed were very positive about how interactive lessons were, and how much they got to work with other students. They said they preferred working with other students, and they did this *"Loads"*. It was highlighted that it gave the lesson more *"dimensions"* and made it *"more dynamic"*. This is clearly a positive of Flipped learning, as the opportunity to work interactively clearly raised the students' engagement in the lesson. This is also mirrored in the responses to section A, with 90 percent of pupils agreeing or strongly agreeing that the lessons were engaging. This is likely due to having more lesson time to do interactive activities rather than the teacher talking. This is backed up by the fact that during the interview, the students said *"there's always lesson time"* to do activities. Whether or not I decide to use Flipped learning in my future practice, one thing that my enquiry has shown me, is how much pupils value interacting with one another and learning from one another in lesson times. This would be something I would be keen to involve in my lessons.

However, whilst students thought the lessons were interactive, 40% disagreed that the lessons gave them the opportunity to interact more with other students. This could be due to the fact that some pupils will not need as much help or support from their peers as others. If the students do not need the support, then they are less likely to interact with other students as much.

Independence

Independent learning was highlighted by students as both one of the benefits and one of the drawbacks of Flipped learning. This proves to be a divisive theme, with some enjoying the independence and finding it beneficial and others finding it a disadvantage to Flipped learning. Some students did clearly find the independent aspect beneficial, with students putting it down as the main benefit of the way they are taught. I think that Flipped learning is more suited to the sixth form students that this enquiry was undertaken on, as they are often more motivated and understand that independent learning is the norm at university. One response cited this directly as one of the benefits saying that it *"Prepares you for university and teaches you to set targets and manage your own work"*.

However, some students felt that the independent aspect of Flipped learning was a hindrance, with students stating that they sometimes struggled to understand the pre-reading, and that they felt pressured to work things out themselves rather than ask a teacher. *"I sometimes feel like I can't ask the teachers for help because they are always going on about pre-reading and being independent. As a result, I assume that I should learn the topic myself"* This suggests that students may be apprehensive to ask the teacher for help, as they think they have to learn everything on their own.

Interaction with the teacher

A major theme in terms of what students find beneficial about lesson time was the interaction between students and the teacher. The majority of students agreed or strongly agreed that Flipped learning gave them more time interacting with their teacher. In terms of the types of interactions, student response in the interview said that rather than the teacher lecturing at the front of the class, there were more *"class discussions"*. It also appears that students think that the teacher has more time to interact with students one-to-one, with the students interviewed saying that the teacher will *"wander round"* and *"Check up on us"*. The fact that this was noticeable to students suggests that there is an appreciable difference in the way the teacher spends time in Flipped learning compared to conventional teaching. Students stated that in the questionnaire that they found the interactions with teachers beneficial. When asked about the benefits of lesson time, the opportunity to *"receive a one-to-one feedback"* and having the *"Opportunity to do questions and ask teacher in class"* were brought forward. This indicates that the students value the extra time that teaching staff appear to have in lessons as a result of Flipped learning.

Drawbacks of the enquiry

Whilst positive results were obtained, there are several drawbacks with the enquiry. The small sample size means that it is not representative of the whole population, and the results are specific only to this context. Being a small sample size, one person's bias would have larger impact on study and so results may not be indicative of secondary students' opinions of Flipped learning as a whole. Likewise, being in an all-girls grammar school, the study does not consider the opinions of male students, or those of a lower academic ability. Again, meaning the results do not indicate the views of all secondary students.

Whilst students have indicated that they benefit from more interaction with the teacher, this could be because in sixth form, there are smaller class sizes. When asked the questions regarding Flipped learning, they were asked to compare it to how they were taught at GCSE. Here students would have been in larger teaching classes, and so would have less time to interact with the teacher one on one compared with sixth form. This is another drawback of this current enquiry.

Conclusion

Overall, the sixth form students involved with Flipped learning have a largely positive opinion of the method of teaching. The fact that the most common response from students for all questions 1 to 8 from section A of the questionnaire was 'agree' indicates that they find it engaging, interactive and beneficial. By further developing the results with qualitative responses, it was found that the students thought benefits of Flipped learning were the opportunity to learn at their own pace, interactive lesson times which gave them the opportunity to interact with the teacher and other pupils and the fact that learning new material at home meant they were better prepared for lesson time. Not all the opinions of Flipped learning were positive and the fact that it is largely independent learning was a divisive theme, with some finding this positive, and others finding it a draw back. As my first job is within a sixth form college, the possibility of making use of Flipped learning is certainly on the horizon. However, it will largely depend on the nature of the teaching style used in the college. Additionally, if I were to be the only teacher in the department to use Flipped learning it could be confusing for students. If not using Flipped learning in its entirety, the enquiry has certainly brought forward some things to consider for my teaching. Students appear to value interaction with other students, interaction with the teacher and engaging lessons; each of which could be done without using Flipped learning.

References

- Bergmann, J. and Sams, A. (2009) 'Remixing Chemistry Class: Two Colorado Teachers Make Vodcasts of Their Lectures to Free Up Class Time for Hands-On Activities', *Learning and Leading with Technology*, 36(4), pp 22-27
- Clark, K. R. (2015). 'The Effects of the Flipped Model on Instruction on Student Engagement and Performance in the Secondary Mathematics Classroom', *Journal of Educators Online*, 12(1), pp. 91-115
- De Araujo, Z., Otten, S. and Birisci, S. (2017) 'Mathematics teachers' motivations for, and conceptions of, and experiences with flipped instruction', *Teaching and Teacher Education*, 62, pp. 60-70
- Flipped Learning Network (FLN). (2014) *The Four Pillars of F-L-I-P*. Available at: https://flippedlearning.org/wp-content/uploads/2016/07/FLIP_handout_FNL_Web.pdf, (Accessed: 11 March 2017).
- He, W., Holton A., Farkas, G. and Warschauer, M. (2016) 'The effects of flipped instruction on out-of-class study time, exam performance, and student perceptions', *Learning and Instruction*, 45, pp. 61-71
- Herraid, C. F. and Schiller, N. A. (2013) 'Case Studies and the Flipped Classroom', *Journal of College Science Teaching*, 42(5), pp. 62-66
- Kurbanoglu and B. Akkoyunlu (2017), Chapter 3, Information literacy and flipped learning, in Sales, D. and Pinto, M. (eds.) *Pathways into Information Literacy and Communities of Practice*: Elsevier, pp. 53-84.
- Lage, M. J., Platt, G. J. and Treglia, M. (2000) 'Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment', *The Journal of Economic Education*, 31, pp. 30-43
- Roehl, A., Reddy, S. L., and Shannon, G. J. (2013) 'The Flipped Classroom: An Opportunity To Engage Millennial Students Through Active Learning Strategies', *Journal of Family and Consumer Sciences*, 105(2), pp. 44-49
- Talbert, R. (2017) *No, you do not need to use video in flipped learning (and five alternatives)*. Available at: <http://rtalbert.org/flipped-learning-without-video/>, (Accessed: 11 March 2017).
- Wellington, J. and Osborne, J. (2001) 'Language and literacy in science education', Buckingham: Open University Press.