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FLIPPED LEARNING

PRACTITIONER GUIDE

National Foundation for Educational Research (NFER) and Nesta

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PART 1

Introduction

1.1 About this guide

This document provides guidance to schools on how to implement flipped learning and the potential benefits of this approach. Flipped learning involves using digital technology, such as video, to provide direct instruction on new concepts outside of the classroom. As students come to lessons with a preliminary understanding of the topic, this frees up class time for the teacher to focus on other beneficial learning activities. Students can then use lessons to build their understanding through discussion, collaborative activities and more practice. It can lead to students moving through content at their own pace, covering more, and in greater depth. It also fosters independent learning skills, making students aware of how they move through material, what they find difficult and what they excel at.

This guidance is intended for teachers and other members of staff in school who are thinking about using flipped learning in their teaching. It is based on the findings of a research study carried out by the National Foundation for Educational Research (NFER) and Nesta, between January 2014 and August 2015, exploring teachers' and students' experiences of implementing flipped learning across nine case-study schools.

While our case-study schools focused on the use of flipped learning in mathematics, the approaches and their experiences could be applied to any subject area where appropriate flipped learning resources are available, or there is staff capacity to create them.

This guide can be read alongside the companion handbook which was produced to help teachers in case-study schools to implement a flipped learning approach using Khan Academy resources. The handbook provides step-by-step instructions for the process and maps the Khan Academy mathematics resources to the relevant curricula in England and Scotland.

In brief, this guidance document:

• Provides an understanding of flipped learning and the Khan Academy resources which were used in the study	Page 6
• Highlights the key benefits to schools in using flipped learning	Page 9
• Outlines what schools need to consider and put in place when planning to use flipped learning	Page 12
• Explores the key challenges to implementing flipped learning	Page 15
• Presents three distinct approaches to using flipped learning	Page 17
• Summarises the main messages	Page 23
• Signposts readers to useful sources of information and contacts	Page 25

1.2 About the research study

A small case-study design was used to explore whether the activities taking place in the ‘flipped classroom’ differed to those being delivered in a more traditional way and whether this model of learning was likely to lead to improved attainment or deeper subject understanding.

Nine schools were involved in the study, of which five were located in Scotland and four in England. The study focused on the use of flipped learning in mathematics lessons for Key Stage 3 students in England and Secondary 1-3 in Scotland. In each case-study school, one class used a flipped classroom model and one class was taught the same content in a more traditional way. Schools were encouraged to use Khan Academy resources for flipped learning activities and these were mapped to the relevant mathematics curricula in England and Scotland to support teachers in choosing appropriate resources. Case-study schools were also provided with a guidance document to support their delivery of flipped learning and use of Khan Academy materials.

The research design included school case-study visits which involved lesson observations, teacher interviews, student focus groups, and teacher and student questionnaires, with both the class using a flipped learning approach and the comparison class who were taught mathematics in a more traditional way.

PART 2

Flipped learning and resources

This section describes what flipped learning is and provides information on some of the resources available to support a flipped learning approach.

2.1 What is flipped learning?

Flipped learning involves the use of technology to maximise the time spent on active learning in school. Part of the learning process (usually direct instruction of new concepts through video) is accessed by students outside of the school day. This frees up classroom time for other activities, such as practising and applying knowledge and skills, collaborative learning and individualised support from the teacher, particularly to support students who are struggling. For the purposes of this study, we used the following definition of flipped learning:

In flipped learning, delivery of content is undertaken via video instruction accessed online. Class time is focused on supporting students in working out the problems themselves. The activities undertaken in the classroom should, where available, be informed by online data (such as that collected through practice questions) which will show teachers what their students are doing and the pace they are moving at.

Some of the main differences between a traditional classroom and a flipped classroom (as found in our study) are illustrated in the following diagram.

Traditional classroom

- Teacher prepares and delivers instruction on concept/topic to the whole class
- Students listen in class and make notes
- Students complete tasks to develop their understanding
- Homework is assigned mainly to consolidate understanding
- Teacher’s role is to lead the lesson/pass on knowledge
- Learning activities are predominantly offline (textbooks and worksheets)



Flipped classroom

- Teacher prepares/selects materials for students to access instruction on concept/topic outside of class
- Students watch online/digital videos/do exercises as part of homework to prepare for lessons
- Class time is devoted to active learning, extension activities and supporting individual students
- Students receive support from teacher and peers as needed
- Teacher’s role is mainly to facilitate student-led learning



2.2 The Khan Academy resources

As part of our study, teachers were asked to use Khan Academy mathematics resources in their delivery of flipped learning. Relevant resources were mapped to the curricula for Key Stage 3 in England and Secondary 1-3 in Scotland to support teachers in identifying appropriate resources for their class in terms of level and content.

Khan Academy was founded in 2006 and it is one of the world’s most popular education websites. It describes its mission as providing ‘a free world-class education for anyone, everywhere’. Khan Academy offers more than 5,500 instructional videos, of which approximately 3,500 are about mathematics. It also offers more than 100,000 practice mathematics problems that students can complete at their own pace.

From its original roots in video instruction, Khan Academy has expanded its resources to provide a range of problems and exercises for students to complete to practise and develop their learning of concepts. These exercises are delivered using an ‘adaptive’ approach, which responds to students’ performance and alters the questions delivered based on their previous answers. The system also records and tracks students’ activities and performance to provide information for teachers on how well they are doing.

The Khan Academy website offers some powerful reporting functions of benefit to teachers which allow them to:

- Explore gaps in students' understanding of key concepts: this affords the possibility of creating a baseline from which one can measure future improvement.
- Identify students who are struggling with a specific topic or concept: this identification, along with other data, can help teachers to select which approach might work best with different students - for example, peer tutoring with a proficient student or a one-to-one session or small group work with students who are struggling.
- Diagnose learning challenges: teachers are provided with data on how students have used the Khan resources. They will know, for example, whether or not a student has viewed the video, and how many problems they have attempted. This information can help teachers to pinpoint conceptual misunderstandings and behavioural or confidence issues.

2.3 Other resources

Teachers in the study used various existing instructional video resources to implement a flipped learning approach. They selected resources that aligned with the curriculum, their own approach to teaching, and that were appropriate for their students' age range and abilities. Some teachers chose digital resources that stretched and challenged their students, while others preferred resources that more heavily scaffolded and guided student learning. One of the findings from our study was that not every case-study school found Khan Academy to be the right tool for them. Some teachers preferred to use other resources, or to use additional resources alongside Khan Academy. These included:

- **Hegarty Maths** (www.hegartymaths.com) - set up in 2011, and inspired by Khan Academy, Hegarty Maths provides videos and resources for all aspects of the mathematics curriculum that enable students to improve their mathematical skills in and outside of the classroom. There is a free and a paid-for version.
- **MathsWatch** (www.mathswatch.co.uk) - MathsWatch is a set of mathematics resources (videos and worksheets) available to schools/colleges via an online subscription service or via the purchase of individual discs (playable on any Windows® PC).
- **MyMaths** (www.mymaths.co.uk) - MyMaths is an online learning platform for schools. Although based in the UK, MyMaths is used in over 70 countries and by over four million students a year. MyMaths provides access to a range of ready-made lessons and online homework tasks.
- **YouTube** (www.youtube.com) - launched in May 2005, YouTube allows people to discover, watch and share originally-created videos, including a range of educational resources.
- **BBC Bitesize** (www.bbc.co.uk/education) - launched in 1998, this is a free online study support resource for primary and secondary students across the UK. Bitesize is available on a variety of platforms, including web and mobile phones, and provides a range of classroom resources, such as video clips, activities and tests.
- **NCETM** (National Centre for Excellence in the Teaching of Mathematics) (www.ncetm.org.uk) provides mathematics teaching resources, including schemes of work, lesson plans and links to other online resources.
- **Mathsrevision.com** (www.mathsrevision.com) - this is a set of mathematics resources (presentations, lessons and exercises) available online which were created by a teacher and are linked to the Scottish mathematics curriculum.

These resources have been listed to give a flavour of the range of resources available to support a flipped learning approach and the list is by no means exhaustive. The research team does not recommend or endorse these, or any one resource over any other.

PART 3

What are the benefits of flipped learning?

This section describes the benefits of using flipped learning when it is effectively implemented and students actively engage with the approach. The focus below is on case-study teachers' views of the impacts related to mathematics teaching and learning. However, it is likely that similar impacts would be achieved for other subjects which lend themselves to a flipped learning approach.

The range of impacts that can be realised from flipped learning on teaching and learning practice, and on students, are highlighted below.

Impacts on teaching and learning practice

- As a result of students learning and grasping new concepts and topics at home, **teachers do not need to spend as much time on explanations at the start of lessons**. The time that is saved can then be used in a range of beneficial ways as detailed below.

“The flipped learning approach means that you get more out of the lesson because you already have a bit of knowledge before you go in. The teacher would usually have to explain for most of the lesson if she's starting a new topic, so she doesn't have to do that as much, so we get more done and get onto harder questions.”

(Student, case study 1).

- More time in lessons can be spent on: students **practising and applying knowledge and skills, as well as questioning and higher level discussions**. Teachers can also focus more on **addressing misconceptions, consolidating learning, and setting extension activities**.
- The approach allows more scope for **peer-to-peer and collaborative learning**. Students come to lessons with prior learning and are, as a result, well prepared and more confident to participate in paired, group and whole-class activities and to support each other (e.g. explaining concepts to peers).
- Flipped learning enables teachers to facilitate more opportunities for **independent and student-led learning**, with students working through the videos and exercises at their own pace at home. The approach puts the onus on students to take responsibility for their own learning rather than relying on their teacher to impart all of the information.

“They’ve got the chance to spend as long as they like on it whereas, in class, they don’t really get that chance because someone will get it in two minutes but they maybe need 15, it can really set them back. Whereas if they all get chance to do it at home, one person took two minutes, one took 15, it doesn’t matter because they’ve all come to class and they are ready to move on from that point together...”

(Teacher, case study 1).

- The approach allows teachers to take more of a coaching role and spend more time **providing individual support to students or supporting students in small groups**. This can include both supporting students who are struggling as well as moving students who have grasped the concept on to extension activities. Feedback on students’ performance in online activities (e.g. provided by Khan Academy) can inform teachers’ lesson planning, helping them to understand the stage that each student is at and to plan more individualised support.
- Flipped learning also enables teachers to **gain a better understanding of students’ preferences for different approaches to learning** and, in particular, provides an opportunity for them to see which students respond well to independent learning.

“It helped us to identify those pupils that are responsible and independent in their learning and are most determined to succeed. When you take away the person at the front and say ‘it’s over to you’, some pupils at that age can respond to that... It’s given me a really good insight into who’s doing the work and who’s really keen.”

(Teacher, case study 1).

Impacts on students’ engagement, learning and skills

- Flipped learning can be **engaging and ‘fun’ for students**, as a result of it being a new and fresh approach and a change from traditional teaching approaches that use technology less frequently. In turn, **students’ increased enjoyment of lessons and homework can positively impact on their attitudes towards mathematics as a subject**.
- The approach can help students to develop a **deeper knowledge and understanding** of mathematics topics. This is as a result of students having more time to absorb the information at their own pace out of lessons and then having more time in lessons to: practise and apply skills; participate in discussions and peer-to-peer learning; and receive more individualised support to further extend and consolidate their knowledge.

“If one of our friends didn’t watch it we will explain it... we all kind of work together... I think it’s good because it makes you understand better if you explain it to someone else.”

(Student, case study 5).

- Another important impact is **students’ increased confidence in mathematics**. This is related to their increased knowledge and understanding gained through regular homework and independent learning, which can result in a realisation that they can be successful in mathematics.
- Flipped learning can result in **students’ increased understanding of their strengths and areas for development**. Through the process, they become more accurate and detailed in identifying these areas, and online feedback on how they are doing can increase their awareness.
- The approach encourages and supports students in developing skills as **more independent learners** through encouraging them to work through the resources at home without the support of a teacher.
- Flipped learning can **increase students’ progress and has the potential to improve attainment**. Lessons move more quickly onto task, they progress at a faster pace, and students have more time to consolidate and extend their learning and be supported with misconceptions.

“I have found that I am able to move at a much faster pace than I was before. I was finding that I couldn’t cover everything I wanted in lesson but I am definitely getting more out of them now. They are definitely making more progress as a result of flipped learning.”

(Teacher, case study 9).

PART 4

What are the key considerations in implementing flipped learning?

This section draws on participants' experiences in case-study schools to outline some of the key aspects to consider when implementing a flipped learning approach.

The key considerations when implementing flipped learning are outlined below.

Technology

- Check that the school's broadband speed is suitable for accessing resources in lessons and that the IT suite is free when needed.
- Check that students have access to reliable broadband and a PC/laptop/tablet/smart phone at home, or can access the school's IT suite/library regularly outside of lesson time.

Homework

- Ensure that the flipped learning approach fits with the school's homework culture and policy to ensure high levels of student engagement with completing homework. If this is not in place, consider how you will gradually develop this culture or how the resources will be accessed by students during school time.

Teaching

- Consider whether the flipped learning approach fits with your teaching style and approach - it suits an open ended, coaching role best, and this would need to be adopted to make the most of the approach.

Learning

- Consider whether this type of independent learning will suit your students and what preparation they will need. For example, you might want to run some pilot sessions in class in which students are introduced to, and guided through, the approach. This will help you prepare them for flipped learning homework, as well as gauge how they are likely to get on working independently at home.
- Prepare students for the approach, explaining clearly that viewing the materials for homework is an expectation and a necessity, and that not doing it will result in sanctions that will be consistently followed up.

Parents/carers

- Consider informing parents/carers and asking for their support with your chosen approach.

Resources

- Carefully select the materials you are going to use for flipped learning. You need to ensure that the content:
 - relates closely to the topic being covered
 - uses terms and language that match that used in class (American videos can use different terms and language)
 - can be accessed by the whole class i.e. all ability levels (there may be different videos catering for different levels)
 - allows for differentiation - learning needs to be scaffolded allowing students to access increasing levels of challenge as they progress
 - provides video explanation that closely relates to follow-up exercises to test understanding
 - provides students with feedback and a sense of progression and achievement (content that is too challenging to start with can lead to a drop in confidence)
 - allows the teacher to access the questions that students will work through and get a feel for what is being asked of them.

When implementing a flipped approach to learning, teachers should:

<p>1. Set and review homework</p>	<ul style="list-style-type: none"> • Set students homework where they watch a video that closely relates to and prepares them for the next lesson • (If available from the resources used) review the data on which students are viewing the materials, how long they are spending, how they are progressing and what areas they are grasping and having difficulties with, so that this understanding can feed into your lesson planning
<p>2. Follow-up during lesson time</p>	<ul style="list-style-type: none"> • Review and recap on the video at the beginning of the lesson and check student understanding so you know which students are struggling with concepts and which require extension activities • Have a clear strategy for how you will help students in lessons with difficulties, both in understanding content and practising skills taught via flipped learning, in order that students do not become frustrated and lose confidence • Have a strategy in place that you can revert to when students have not completed their homework or have found it difficult to grasp • Plan for how you will use any additional class time as students come to lessons prepared (e.g. extension activities, questioning, discussion, collaborative learning, independent learning, providing support to individuals or groups)
<p>3. Encourage peer-to-peer learning</p>	<ul style="list-style-type: none"> • Consider how students who are more confident and further on in their understanding might support those who are struggling to grasp concepts e.g using 'peer-to-peer' learning to pair more able and less able students and/or identifying 'student champions' • (Where needed) consider pairing students who have and have not undertaken the homework to help pupils catch up and to help pupils refine their understanding through explaining concepts to their peers
<p>4. Encourage independent learning skills</p>	<ul style="list-style-type: none"> • Encourage students to take responsibility for their own learning by working through online resources at their own pace at home and undertaking extension activities at home and at school • Consider asking individual students to 'lead' aspects of lessons to demonstrate their learning from their homework and reading around the topic • Where needed, pilot flipped learning in school enabling students to be guided through the approach within a supportive environment'
<p>5. Review and make changes if necessary</p>	<ul style="list-style-type: none"> • Be prepared to tweak and alter the approach in response to student feedback and your own observation of how flipped learning is working

PART 5

What are the challenges to using flipped learning?

In this section, we summarise the challenges and barriers that teachers reported encountering in implementing flipped learning. In some cases, they were overcome, resulting in the success of the approach. In others, particular challenges and barriers limited the impact achieved.

The range of challenges and barriers that teachers faced in implementing flipped learning are summarised below.

Access to technology

- Students' lack of access to equipment and internet at home, within lessons, and in the school's IT suite, can be a barrier to success. Some schools in the study also faced issues related to software and operating systems which were incompatible with the chosen online and digital resources as well as issues with internet speed.

Identifying appropriate online resources

- Some teachers found certain resources unsuitable because:
 - the level and type of content and the mathematical language used did not match that of lessons
 - they did not scaffold learning effectively, but started with more complex concepts and exercises and worked backwards – some students can find this approach demotivating and it can reduce confidence
 - practice questions were not well linked to the content of the video
 - they were not easily accessible
 - they used terminology which was unfamiliar to students.

Students not participating in preliminary homework

- In schools where there is not a strong culture of homework and students cannot be relied upon to complete homework, this can be a barrier to the success of flipped learning. Students will struggle with classwork which is based on them having gained a preliminary level of knowledge and understanding at home.

Students' preferences for traditional modes of learning

- Where students are not engaged or confident with this mode of learning, the approach may not be effective or time will be needed for them to adjust. Some students may not respond well to taking responsibility for their own learning by undertaking online learning at home and may prefer face-to-face contact with a teacher. Others may prefer a permanent written record of the work they have completed which online learning does not always provide without additional note taking.

Teacher role and management of the change process

- Teachers who view the direct instruction element of teaching as central to their practice may not be comfortable delegating this aspect to technology (or a remote, online teacher).
- In addition, the approach requires a culture shift in schools to a different way of working, as well as flexibility to adapt and refine the approach in line with feedback, and to overcome the barriers that emerge. This approach may not suit some teachers or be compatible with the culture of some schools.

PART 6

Three approaches to using flipped learning

This section presents three approaches to flipped learning which you might consider implementing in your school. These are:

- The whole class model.
- The carousel model.
- The managed homework model.

The different approaches suit schools with different contexts and policies e.g. in relation to homework and students with different learning styles.

Approach 1: The Whole Class Model

Key features

- School has a homework policy and students are conscientious in completing homework.
- School aims to develop active approaches to learning, giving responsibility to students.
- Students are prepared to take some responsibility for their learning.
- Teachers are prepared to take a student-centered, personalised approach where different students may be at different stages of learning at any one time.
- Teachers take on a coaching role, diagnosing and addressing student needs, misconceptions and developing capacity for further challenge.
- Students take on an active role, taking responsibility for their learning and developing an understanding of their strengths and weaknesses.

Processes

- Students undertake preparatory learning for homework via video and exercises, focusing on new concepts they have not yet covered in class.
- Teacher views feedback data on student progress (if resources have this feature) to help with lesson preparation and planning for differentiation.
- Teacher may start the lesson with a discussion of the video content and recap, but this will be brief and serve to orient the students to the area of focus rather than directly teach new content.
- Teacher may start lesson with practice exercises with whole class feedback using tools such as whiteboards to assess how well students have grasped concepts at home.
- Students spend lesson time working actively on exercises, supporting each other, independently solving more complex problems, and posing questions to the teacher based on their prior learning or areas of difficulty.
- Teacher uses a coaching and student-centred approach within lessons to address misconceptions and gaps in understanding, as well as to consolidate and extend learning.
- Students may progress through content at different rates, with the teachers setting up an individually personalised approach to learning.
- Lessons end with the teacher setting new content for learning at home using flipped learning resources.

Evaluative view

- Can lead to increased student learning as students come to lessons prepared and can progress at their own pace, and the teacher can support individuals who are struggling as others continue to progress and extend their learning.
- Student access to technology outside of lessons is crucial to this approach. This can be either at home or through opening up access to school facilities before the school day, at break and lunch-times and after school.
- A strong culture of completing homework is important, as engagement with lesson activities depends on having completed learning at home.

- The resources chosen must be appropriate to the students' level of understanding and their capacities for independent learning. The teacher needs to be able to trust in the quality and appropriateness of the resources to be able to confidently delegate direct instruction to them, and focus on diagnosing the individual and group needs of students, and intervening to support them.
- Students may be at different stages of understanding and any time spent recapping video content can be disengaging to those who have already covered and understood them.

A vignette illustrating how a pilot school followed a similar approach is provided below. The teacher, based in a school in Scotland, used Khan Academy materials and analytical reports to monitor levels of engagement and tailor lessons to concentrate on areas of low performance.

VIGNETTE 1: FLIPPED LEARNING USING THE WHOLE CLASS MODEL

The flipped learning pilot was carried out with a Secondary 3 class (aged 13-14 years) of high ability students. The class was introduced to a topic on graphical functions using Khan Academy videos and exercises during homework time. Class lessons then began with the teacher displaying the results of the analytics from the homework exercise on the board. As students entered the lessons they could see how well they and their peers had done. The use of the Khan Academy analytics data allowed the students to compare their performance with peers and for the teacher to monitor participation and understanding and diagnose the need for further support. The teacher's introduction to the lesson was brief and quickly progressed to setting students a problem-solving activity based on the topic. The students worked independently through the activity, and those who were stuck were encouraged to consult with their peers who had performed well in the related exercises, based on the displayed analytics of student performance. The class were later brought together as a group to go through the exercise, the teacher inviting different approaches to solving it and offering praise for different methods. For the remainder of the lesson, students worked independently through textbook questions, interacting with each other to seek or offer help. The teacher spent extended time with individuals and pairs who were struggling and, at one point, brought the whole class together to complete a worked example, inviting student contributions. The teacher reported that the lesson was more student-centred than the usual, more traditional teaching approach. The teacher planned to continue using a flipped learning approach to complement more traditional methods and to teach particular mathematics topics, and will encourage other members of their department to do so. The teacher also intended to continue to use Khan Academy materials and analytics data for diagnostic purposes.

Approach 2: The Carousel Model

Key features

- School has a homework policy and students are conscientious in completing homework.
- The school's approach to teaching mathematics is small group and paired work.

- This model allows for the fact that some students may not watch the online videos as part of homework.
- Uses a blended approach (a combination of paper and computer-based activities) during lesson time.
- Works best with students who have developed skills to be independent learners.

Processes

- Students undertake learning for homework via video and online practice questions.
- Teacher reviews feedback on what students have done at home and/or recaps at the beginning of the lesson to gauge understanding and which students will need support.
- Lessons focus on developing understanding through: a) carousel of activities – students work in groups and rotate around different activities (including a work station in which they can view the video set as homework and undertake associated exercises on iPads/laptops); b) paired work in which students who have grasped the concept support those who have not to 'get them up to speed' (peer-to-peer learning).

Evaluative view

- Increases student progress as students have undertaken preparation outside of lesson time.
- Encourages student collaboration and more time for student discussion and questioning.
- Encourages independent learning.
- Students can work at their own pace.
- Blended approach acts a failsafe (in case the technology component fails).
- Carousel approach maintains student interest and results in a fast-paced lesson.

A vignette illustrating how a pilot school followed a similar approach is provided below. The teacher, based in a school in Scotland, used class time to rotate students around different activities. This included an iPad work station in which students viewed videos and undertook exercises on the Khan Academy site.

VIGNETTE 2: FLIPPED LEARNING USING THE CAROUSEL MODEL

The flipped learning pilot was carried out with a Secondary 4 class (aged 14-15 years) of lower ability students. The students were asked to watch selected Khan Academy mathematics videos and complete related exercises on the topic of equations for homework. In class lessons, the teacher ran a carousel of different activities with six workstations. A number of iPads were left at one of the stations and, when it was their turn, the students logged into Khan Academy. They then spent about 15 minutes working through the homework tasks, or, if these had already been completed, continuing through the activities set for them by the teacher. The students worked independently through the activity and those who were stuck were encouraged to consult with their peers or to wait for the teacher, who moved around the different workstations supporting students

as necessary. The class was later brought together as a group to go through the different exercises and to check understanding. One of the benefits of this approach was that students had more opportunities to practise and apply skills and were beginning to recognise that practising to solve problems was helping to improve their understanding. As the class teacher commented: 'I think that they got the notion that...practising...can have an impact. They are beginning to see that, with lots of practise, they are actually getting some mastery of the topics'. The students were able to work at their own pace through the various activities, facilitating a personalised approach to learning. The teacher planned to trial a similar flipped learning approach again with another class to further explore the benefits and considered flipped learning as a potentially useful addition to their teaching tool-kit.

Approach 3: The Managed Homework Model

Key features

- Lack of homework culture in school, some students take seriously and others do not, despite parent support.
- Lack of student access to technology at home.
- Students use flipped learning resources to receive introduction to a topic as part of managed homework sessions, outside of normal lessons, but within the school.

Processes

- Students use flipped learning resources in a managed homework slot as preparation for beginning a new topic in class lessons.
- In the managed homework session, students are supervised to work on individual computers/laptops/iPads and to undertake online and digital activities set by the teacher.
- In the managed homework session, students working on the same activities may work together in pairs or small groups to help each other.
- Students come to subsequent lessons with an initial level of understanding of the topic allowing for more extension work during class, freeing the class teacher to support those who are struggling and students' questions drive the lesson direction.
- Students are encouraged to view videos of their own volition for homework, although the teacher is realistic that not all will do this, and so plans a more structured and supervised opportunity for this.

Evaluative view

- Allows for some of the benefits of The Whole Class Model of flipped learning and maximising of class time with the specialist teacher.
- Ensures all students come to lessons with a basic introduction to a topic.
- Allows for independent learners to consolidate and progress in their understanding while not disadvantaging those who cannot, or chose not to, access resources at home. All students are provided with the opportunity to engage with materials in the managed homework session to prepare them for subsequent lessons taught by the specialist mathematics teacher.

- Personalised and independent learning is encouraged both at home and in the managed homework session, as students can work through online videos and activities at their own pace and begin to take responsibility for their own learning.
- As some students come better prepared to lessons, the teacher has more time in class to support students who are struggling and to consolidate and extend the learning of others.
- Organising access to school computer facilities and a member of staff to supervise a managed homework session may be challenging.

A vignette illustrating how a pilot school followed a similar approach is provided below. The teacher, based in a school in England, explored a flipped learning approach using a weekly managed homework session based in school. The school was in a rural location and access to the internet at students' homes was often unreliable, which prevented the implementation of The Whole Class Model.

VIGNETTE 3: FLIPPED LEARNING USING THE MANAGED HOMEWORK MODEL

The flipped learning pilot was carried out with a Year 7 class (aged 11-12 years) of high ability students. One out of a total of four weekly mathematics lessons was delivered in the computer suite where students used Khan Academy mathematics resources. The lesson was essentially run as a managed homework session supervised by a non-specialist teacher. In the session, students sat at individual work stations and progressed through Khan Academy materials set by the teacher to introduce them to a new topic. The non-specialist teacher encouraged students to help each other if they were having difficulties. Students were also encouraged to engage with the Khan Academy materials as part of homework. However, because of poor internet access at home due to the school's rural setting and an existing homework policy of two hours' homework per night, the teacher was reluctant to place additional burden on the students by making this a formal requirement. Subsequent lessons, taught by the specialist mathematics teacher, continued the topic using offline resources, and built upon students' learning from using Khan Academy resources. In lessons, because students had a prior understanding of the topic, the mathematics teacher had more time to support those students who were struggling while others continued to work independently. Students were reported to be progressing more quickly using this flipped learning approach. They were moving more rapidly onto extension activities and more complex tasks, and also developing more independent learning skills through the managed homework session. The school planned to roll out the approach and continue to use Khan Academy mathematics resources.

PART 7

Summary of the main messages

This small-scale study, undertaken by the National Foundation for Educational Research (NFER) and Nesta, revealed both the benefits and challenges of implementing a flipped learning approach to mathematics teaching.

Flipped learning was used to relocate direct instruction of new concepts to homework time and allocate lesson time to active learning activities. Such activities included pupils practising and applying mathematical knowledge with coaching support provided by the teacher. Where flipped learning was reported to have worked effectively, case-study interviewees reported it had a beneficial effect on student learning. It encouraged students to take responsibility for their learning, allowing them to learn at their own pace, to deepen their knowledge and understanding, and to make faster progress than would otherwise have been the case.

Enabling factors included access to appropriate technology, online resources which were appropriate for the age and ability level of students, a culture of homework participation and teachers' openness to the approach.

Participating schools implemented flipped learning in different ways. This reflected teachers' and students' preferences, as well as practical considerations. These approaches included teachers using online videos and exercises at home, during school time but outside of normal lessons (e.g. as a managed homework session), and as a carousel of activities within lessons. Some students found the use of video technology engaging, others preferred to be able to interact with teachers face-to-face and to ask questions.

Teachers in the study used various existing instructional video resources to implement a flipped learning approach. They selected resources that aligned with the curriculum, their own approach to teaching, and that were appropriate for their students' age range and abilities. Some teachers welcomed online resources that stretched and challenged their students, others preferred resources that more heavily scaffolded and guided student learning. Brief exercises and note-taking linked to the videos encouraged active engagement.

Most of the teachers in the study who piloted a flipped learning approach reported that they would continue to use the approach as part of a varied repertoire of pedagogical strategies. Some teachers planned to embed the use of flipped learning with particular curriculum topics and to extend its use amongst teachers in the mathematics department. Others planned to adopt aspects of a flipped learning approach, such as the use of online video resources, and integrate this into a more traditional model of teaching.

Our findings suggest that there may be scope for teachers to further refine and enhance models of flipped learning beyond those developed as part of this short pilot study. This could include more use of: student-centred and peer-teaching activities; research and problem-solving; extended discussion; and assessment and feedback informed by performance on online activities.

PART 8

Key links and resources

The Khan Academy site www.khanacademy.org

Curriculum mapping documents

Flipped Learning: Research report

Flipped learning: Handbook for schools implementing flipped learning using Khan Academy

All available at www.nesta.org.uk/flipped-learning.

The Khan Academy Coach resources: www.khanacademy.org/coach-res

Hegarty Maths www.hegartymaths.com

MathsWatch www.mathswatch.co.uk

MyMaths www.mymaths.co.uk

YouTube www.youtube.com

BBC Bitesize www.bbc.co.uk/education

NCETM (National Centre for Excellence in the Teaching of Mathematics) www.ncetm.org.uk

Mathsrevision.com www.mathsrevision.com



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