Centres for Excellence in Maths (CfEM)

Aim: To Explore how online platforms can be used to re-engage and motivate disengaged post-16 GCSE Maths re-sit learners

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Action Research Project

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Abstract

The purpose of this action research was to explore the effect of using technology in the online teaching and learning of mathematics for GCSE resit learners with the aim of re-engaging and motivating disengaged post-16 FE learners in the learning of mathematics. The action research involved the author and four teacher researchers. The data was collected using various tools: pre-and post-test surveys, interviews, and measurements – number of questions a learner completed on an online platform. The findings through interviews revealed that technology can play a positive role in engaging learners by providing real-time feedback to students. The interviews also supported the statement from the teachers that real-time feedback was beneficial to learners. The study concluded that learners who answered 250 or more questions online had higher chances of achieving a grade 4+. The findings of the study have further provided some insight into how to efficiently use digital platform by teachers in online mathematics delivery.

About CfEM

Centres for Excellence in Maths (CfEM) is a five-year national improvement programme aimed at delivering sustained improvements in maths outcomes for 16–19-year-olds, up to Level 2, in post-16 settings.

Funded by the Department for Education and delivered by the Education and Training Foundation, the programme is exploring what works for teachers and students, embedding related CPD and good practice, and building networks of maths professionals in colleges.

The DfE created 21 Centres for Excellence in Mathematics (CfEM) in England to research ways of delivering a step change, thus improving the above learner attainment. Harlow College is one of the 21 CfEM and is trialing innovative approaches in carrying out this task. Harlow College has succeeded in recruiting 14 network partners including FE colleges and Sixth Form Colleges who are teaching post-16 GCSE re-sit Maths, so that we can work collaboratively to achieve greater success.

GCSE maths resit learners are learners who have failed GCSE Maths at least once and are required to resit GCSE by a Government Law that was passed 2nd of July 2014. As a result, all FE Colleges and Sixth Form Colleges are doing all they can to help these learners to achieve the desired grade 4+. Since the law in 2014, the FE maths GCSE resit results nationally have been around 18 to 20% pass rate.

Introduction

In colleges, as exemplified by Bellamy (2017), the situation is one where learner feelings are of fear, anxiety, and anger towards mathematics due to their previous failure and previous experiences of maths lessons. The pedagogic approaches used are often only transmission and didactic, requiring learners to memorise most of the content.

At Harlow, one of the CfEM centres for example, the grade 4+ pass rate is just above 35% due to the new teaching approaches that we have introduced which is more of a dialogic approach and are still working on the approach to perfect it. We are also trialling other strategies such as effective questioning techniques. However, about 30% of learners who had previously achieved a grade 3 are achieving a grade 2 or below in their beginning-of-year assessment and it seems as though we are un-teaching the learners, but we believe that this is due to the gap between the end of their last lessons at school and the time they start at college during which they forget the skills learnt at school, so when they start with us they are no longer working at grade 3. This is illustrated from their diagnostic assessment at college where most learners with grade 3, achieve entry level 3 or less. During in-class assessment most say that they no longer remember.

For this action research, Harlow College worked in collaboration with USP College on an Action Research, to find out the impact of the use of Technology in engaging 16–19-year-old maths learners.

It is an acknowledged fact across the Further Education sector that learners forced to retake their GCSEs at college can find it difficult to engage, many would have failed maths multiple times and, as a result, they arrive at college with negative attitudes and fixed mindsets about maths. Digital technology, on the other hand, is intrinsic in young people's lives, and provides the potential to re-engage learners and help give them that push towards a grade 4.

At the same time, in the wake of the coronavirus, schools and colleges across the globe have closed and remained closed as instructed by the government. As a result, teachers are suddenly faced with the challenge of how to continue their students' education. Whilst this might seem a daunting task, there are several ways teachers can utilise the technology and resources already available to support online learning and ensure students still receive a quality education. It is important to note that there is no 'one size fits all' when it comes to learning. Different groups have different priorities and the resources that should be used are context dependent. There are also special considerations to think about for students with Special Educational Needs and Disabilities (SEND), and for students who might not have access to high-speed broadband.

Within this climate we will use different forms of technology to make teaching and learning more effective thereby engaging learners both with their teachers and some independent learning. If students are engaged in their learning, there is likely to be a retention of knowledge. Different forms of technology can be used to experiment with and decide what works best for students in terms of retaining their knowledge.

Learners learn in different ways due to different learning styles and abilities. Technology provides great opportunities for making learning more effective for everyone with different needs through access to multimedia resources and instant feedback. For example, by using Blutick learners can learn at their own pace, review difficult concepts, or skip ahead if they need to. Moreover, technology can provide more opportunities for struggling or disabled learners.

National success rates are low and although the success rates at Harlow College have been consistently and significantly higher than the national rate, we continue to look for ways to improve upon our previous rate. Every year we set targets in our QIP of 10% higher than the previous year. By increasing learner engagement through technology, we aim to improve attainment levels at grade 4+. A Grade 4+ maths qualification is important economically as it affects available job roles, employability, social mobility, life chances etc. By using technology which learners already use regularly, for example mobile phones, learners have the opportunity to engage with maths more regularly outside the classroom and hence gain the skills they will need to achieve a grade 4. Technology could help in the learning and teaching of maths as teachers can focus more on the content rather than managing behaviour which is often the case.

A wide variety of apps or online resources (platforms) are available to enhance traditional ways of teaching and to keep students engaged. The focus could be on either Blutick or Century or both. Both Blutick and Century are AI powered learning solutions which cover full curriculum and give immediate intelligent feedback to learners when they make a mistake just like having their own personal tutor, thereby helping them during independent learning. Homework and classwork can be set easily, are marked automatically and teachers get detailed feedback on the students' progress, hence saving valuable time. This saved time can be used to work with students who are struggling on a 1:1 basis, to address individual gaps in knowledge. Most importantly, having virtual learning environments enhances collaboration and knowledge sharing between teachers.

During the Covid-19 pandemic, we embraced 100% online teaching, to reduce the spread of the virus. New students were seen face to face at induction during which they were signed up for the online teaching and learning as well as meeting their teachers. With the restrictions relaxed, we are now reviewing this approach and are likely to go back face to face 100%.

Background

Harlow College has 1300 learners 16-18 years of age studying maths ranging from E3 to L2 FS or GCSE re-sit, and a further 300 Apprentices studying maths as part of their course framework. Harlow College decided to enrol learners with a grade 3 onto the GCSE resit programme, and learners with a grade 2 on functional skills level 2 whilst those with grade 1 are enrolled onto FS level 1. On the other hand, all maths students at USP are enrolled directly onto GCSE re-sit programme irrespective of the grade they start with. Each college meeting the government requirement in different ways.

As acknowledged, young adults joining colleges from schools are disengaged due to negative attitudes towards learning maths at school, caused by multiple factors, including negative prior experiences with learning, peer pressure and lack of confidence, Education and Training Foundation, (2014). These issues are not limited to Harlow and USP College but are a country wide problem.

Learner outcomes in GCSE maths resits in FE sector are of importance to all colleges and society to ensure that the UK workforce has sufficient quantitative skills for an increasingly data-driven and technology-rich future. The national achievement rate of grade 9 – 4 or A*-C in Maths of all secondary schools in England is about 40% and the pass rate of post 16-18 GCSE maths re-sit within the FE sector sits at under 20%.

We note that many learners continue to experience an uninspiring mathematics lesson in which learning is limited to memorising and practising maths procedures, with little understanding of their applications, purpose or underlying concepts (Foster,2013; OFSTED, 2012), resulting in a large proportion of disaffected learners, Nardi and Steward (2003). It should be noted that negative experiences of mathematics are not limited to England. Skovsmose (2011) highlights the dominance worldwide teaching approach in which teachers demonstrate mathematical procedure to students who then complete a series of almost identical closed questions. As a result, large numbers of children and adults exhibit anxiety towards, and alienation from mathematics, which is commonly perceived by the general public as 'dull, irrelevant, useless and often harmful', Grootenboer (2013), p. 324).

Literature Review

This section of the report is a review on the use of technology to support better attainment of GCSE maths by post-16 learners in the FE sector. As very little is written about interventions and strategies within the FE sector, this review will explore available literature that describes the use of technology to help students with their learning of mathematics in general as skills could be transferable. However, as, we are conscious that GCSE resit learners in FE are likely to be less engaged and have more negative views of maths, we are not sure if the same interventions from school will be as effective in FE sector. In FE so far, technology is mostly used to assess students' starting points as a requirement for Ofsted and, due to challenges, it is often difficult to utilise the outcomes of these assessments results to design lessons tailored to individual learners to improve their learning and understanding. For example, Ngo and Kwon (2015), investigated the use of data to inform the starting points of students on a maths course but little is known regarding how the information is followed through in the classroom. In most cases the use of technology for initial assessment is mostly as a tick box exercise. This research therefore seeks to examine the impact of online platforms on learner engagement, motivation and improving learning once learners are already placed in their correct starting classes from the initial assessment.

There are platforms such as EEDI, Blutick and Century Tech which use artificial intelligence (AI) and provide adaptive questioning techniques such that when a student's answer is correct, the programme then generates the next question which is slightly harder building on the ability of the learner, one aim of which is to build the student's confidence. Roschelle et al. (2016) in their online mathematics homework, explore the impact and uses of technology. They used an online platform that assists students while they solve mathematics problems and concluded that building confidence and fluency is important, and the non-judgemental feedback given by the technology can provide an ideal environment for their mathematical practice. In our research we are going to use Blutick, or Century Tech or Virtual Reality because they are available in our colleges and can assist students with their learning by giving instant feedback and links to videos that explain concepts that students may still be struggling with.

Kehrer et al. (2013) in their research on the timing of feedback on homework used a very strong methodology and also reviewed 69 papers on the effectiveness of homework and had very significant results that led to a very strong conclusion that when feedback is given immediately, students learned more than when receiving the same feedback later and this is possible through the use of technological platforms. Bakker et al. (2012) explored the use of an online tool to develop proportional reasoning skills in a secondary vocational school in the Netherlands and concluded that when a 'computer tool' is used as a high-quality targeted eLearning resource, it can lead to gains in vocational mathematics. It should be noted that it is not solely the technology that enables learning, but the strategic use of the technology by effective teachers. Suh and Moyer (2007) in their research on the use of virtual and physical algebra balances found that the effective use of technology can provide positive impact on learning. LSIS Practitioner Research (2013) supported the fact that effective use of technology in sixth form, FE, HE, and vocational settings can be a quick way to assess learning and give feedback.

Whilst it is important to embrace the benefits of online resources building upon the experience learners have had at school through the use of some platforms such as 'Mymaths', we also have to highlight the importance of ensuring that online materials are regularly updated, and that links are live (Wooler and Pearce 2013). Through the use of online platforms, maths programmes can be personalised for individual learners (Wroe 2013), offering them greater flexibility and learning tailored to their needs. Technology successfully employed by Learndirect includes the use of online interactive whiteboards; instant messaging; online communities; mobile applications and SMS; video libraries; virtual classrooms; WebEx; Webchat; and YouTube. Learn Direct in their response to the House of Commons BIS Committee inquiry into adult literacy and numeracy (2014) referred to their study that showed the positive results achieved in assisting learners to understand mathematical concepts through the use of Makaton - which utilises speech, signs and symbols to support learning.

Hodara (2013) presented a review of the extent and the quality of evidence on reforms intended to improve the 'mathematics readiness' of students entering college in the USA. The review focused on studies relating to changes in mathematics or college success, including early assessment programs in mathematics, mathematics catch-up programmes, and reforms of mathematics delivery or pedagogy such as the use of technology. The evidence on computer-mediated instruction in the developmental maths classroom is very mixed, with some studies finding positive effects and others finding negative effects.

Kyriacou and Goulding (2006) conducted a systematic review of strategies to raise students' motivational effort in Key Stage 4 (KS4) mathematics. The focus of the review was on classroom-based teaching and learning strategies for KS4 and the impact on motivational effort (rather than on outcomes). One of the strategies the review focused on was innovative methods (the use of ICT). They found out that the use of a range of ICT for example, interactive white boards, videoconferencing, and software packages was motivating to learners. Distinction was made by the authors between the motivational effect of ICT as novelty and the motivating effect of ICT in a way that enhances deeper understanding of mathematics. It was concluded the use of ICT can be positive if they are implemented sensitively and effectively from using technology for diagnostic assessment at the start of the programme to classroom teaching.

In the wake of this pandemic, Harlow College decided to teach 100% through online, and so teaching staff had to be trained in the use of technology and continue to receive support as they deliver online. The training and continuous support for staff ensured that the use of technology is effective and beneficial to the learners as, according to Dick & Hollebrands, (2011), the strategic use of technology strengthens mathematics teaching and learning. The college had recognised the importance of technology in the teaching and learning and had invested in devices for both staff and learners long before Covid-19. Both staff and learners are fairly advanced in the use of technology and professional development on mathematical lessons and integration of digital tools in our daily teaching hence appreciating the power of technology and its potential impact on learners' understanding and use of mathematics (Nelson, Christopher, & Mims, 2009; Pierce & Stacey, 2010).

Using technology in education or teaching helps teachers provide immediate feedback to students and motivates active student learning, collaboration, and cooperation. It

also helps teachers provide individualised learning opportunities and flexibility for their students. In this regard Kelly and McAnear (2002) stated: To live, learn and work successfully in an increasingly complex and in-formation-rich society, students and teachers must use technology effectively.

Aim/Research Question

The use of Technology - How can the use of on-line platforms be effective in engaging and motivating GCSE Maths resits learners?

We would like to say that learner engagement and motivation is a complex construct and there are different definitions out there with no particular one that could be accepted by all (Solomonides 2013). It is also not clear whether engagement and motivation should be used interchangeable, (Reschly & Christenson, 2012). For the purpose of this research, learner engagement is the active participation and the effort they employ within the classroom. It is shaped by a range of different factors including the type of relationships, learning activities and the learning environment.

It is an acknowledged fact that most if not all learners resitting Maths GCSE across the FE sector find it difficult to engage, many of whom have failed to achieve the desired grade multiple times and arrive at college with negative attitudes and fixed mindsets with regards to maths. However, digital technology, on the other hand, is ingrained in young people's lives and provides potential to re-engage learners to help give them that push to achieve the desired grade 4+. At the same time at the wake of coronavirus teachers were suddenly faced with the challenge of how to continue their students' education. While this might seem a daunting task, there are several ways teachers can utilise the technology and resources already available to support online learning and ensure students still receive a quality education. It's important to note that there is no one size fits all when it comes to learning. In this climate therefore, we aim to use different forms of technology to make teaching and learning more effective thereby engaging learners both with their teachers and some independent learning. We aim to use Microsoft Teams to engage learners and their teachers and Blutick or Century for independent learning. If students are engaged in their learning both with their teachers and independently, there is likely to be a retention of knowledge. Acknowledging that learners learn in different ways due to different learning styles and abilities, we envisage that technology will provide great opportunities for making learning more effective for everyone with different needs through the access to multimedia resources and instant feedback. A wide variety of apps or online resources (platforms) are available to enhance traditional ways of teaching and to keep students more engaged and they can easily be downloaded on their smart phones for example. We will focus on Blutick and Century Tech, both are AI- powered learning solutions which cover full curriculum and give immediate intelligent feedback to learners when they make a mistake just like having their own personal tutor thereby helping them during independent learning.

The over-arching aim is to explore how online platforms can be used to re-engage GCSE resit and Functional Skills learners with maths. In order to investigate the aim, we will focus on 3 key areas.

1. To investigate how learners' use online platforms to engage with independent learning
2. To explore how teachers' support learners online learning
3. To explore differences between groups of students and different settings in their response to online learning.

Methods

Technology use in classrooms in today's world is believed to have a positive impact on students' success and their attitudes towards lessons. In this study we investigated students' attitudes towards technology use in class and whether the use of technology improved their engagement in their lessons and learning and subsequently on their achievement.

In this research, 4 teachers participated across two settings, 3 from Harlow College (HC) and 1 from USP college. These were fewer than the original plan of 7 teachers (and approximately 1500 learners) across three settings due to Covid and cyber issues. The total number of maths learners at Harlow College were 134 and 19 learners at USP.

We carried out the research using cycles or a step-by-step approach.

All learners were given a baseline survey to find out their experience about maths. At Harlow, out of the 134 learners that were invited to respond 80 responded and at USP 14 responded to the survey. The baseline survey was designed by obtaining the views of the teachers teaching the students and it was comprised of 14 questions, mostly open. It was used to assess the prior learning experience of learners and prior motivation/engagement in their lessons. Learners were asked to read questions and give an honest response to the questions to help their teachers plan how to support them during the project.

We asked learners to rate the 14 questions from 1 to 5 to investigate their attitudes and preferences in regard to mathematics in general. Since the action research was to investigate the impact of technology on their engagement with maths, the questions ranged from how they currently enjoy maths lessons, how difficult they find maths to how often they do maths outside of the classroom. By this time, we had already introduced Blutick to learners, so we asked them how often they use Blutick as well.

Towards the end of the research, the same set of questions were asked to the learners to compare the responses.

Early on in November we decided to set homework from Blutick due for the next lesson this was to enable learners to practice the skills that they learned in class and practice exam type questions before the next lesson thereby learning and practising mathematics in their own time = independent learning showing that they are motivated to learn.

In our experience, a great advantage of Blutick is that the students have almost a personalised tutor to help them when they get a question wrong. The programme continues to give the learner hints for what they have done wrong, and it also allows the learner to look at a similar example to what they are working on.

However, after several weeks it became clear that setting homework for independent study was not totally successful. There has been a low uptake and learners are easily frustrated by the nuances of the programme. Since motivation is an issue with FE learners, perhaps not understanding why they need to complete the activities or what

the benefits are. Other reasons were that the platform had its own issues such as different formats were requested as answers, which made learners frustrated. Also, there were no consequences for not completing homework and also seemingly no reward for completing the homework. Logging in issues and familiarisation of the platform were both early issues.

However, learners in Harlow who used Blutick didn't like it and it was not helping them to engage with Maths outside of classroom. Consequently, they didn't do the homework that was set for them.

A discussion then took place to find out different strategies and platforms, some of the ideas were that teachers set time aside during lessons or before the end of sessions so that the learners can do their set work before leaving classroom. This approach worked better. Another idea was for teachers to visit other colleges to learn from them how they are using technology, so we went on to have a discussion with Northampton college. Colleagues at Northampton were very helpful and agreed to collaborate with us.

Staff at Harlow college, observed lessons at Northampton and found out that they were using another type of software, called 'Nearpod', this software looked much better and their learners responded better to it.

Teachers then decided to trial it with their learners. Nearpod is an online tool that allows teachers to use slide-based teaching both in the classroom and remotely thanks to a hybrid layout. Teachers can create lots of different interactive learning resources that allow students to engage and learn via their device or a single screen in the room. Teachers started using Nearpod to set tasks for learners and asking them to complete the work as independently as they could, sometimes within their lessons and sometimes outside the lessons.

Results and discussion

The results from a selected number of questions from the baseline assessment in both Harlow College and USP are shown below:

Before the intervention, sixteen out of eighty learners surveyed at Harlow College and five out of 14 at USP were likely or extremely likely to spend extra time doing maths outside of lessons. Most indicated that they were unlikely or neutral.

USP – Baseline Survey

. How likely are you to spend extra time doing maths outside of lessons?
More Details

🔵 1 - not likely at all	0	
🟠 2	3	
🟢 3	6	
🔴 4	4	
🟣 5 - extremely likely	1	

Harlow – Baseline Survey

How likely are you to spend extra time doing maths outside of lessons?
More Details

🔵 1 - not likely at all	8	
🟠 2	20	
🟢 3	36	
🔴 4	12	
🟣 5 - extremely likely	4	

After the intervention with technology and teaching, 17 out of 80 at Harlow College said that they were likely or extremely likely to do maths out of lessons, and the majority indicated that they were unlikely or felt neutral, which is a similar result to the pre-test. Unfortunately, the teacher at USP felt ill and could not do the post-test.

Harlow – Post-test

How likely are you to spend extra time doing maths outside of lessons?

More Details

|		
🔵	1 - not likely at all	7
🟠	2	17
🟢	3	33
🔴	4	10
🟣	5 - extremely likely	7

Initially, 5 learners out of 14 (35.71%) at USP and 32 out of 80 (40%) at Harlow College were likely or extremely likely to ask for help from another student or their teacher. After the intervention, 26 learners out of 80 at Harlow College said they were likely to ask for help, but because the learners who responded to the pre-and post-test surveys were mostly different, these data are not tracking the same learners over a time and so have limited use.

USP - Pre-test

How likely are you to ask another student or your teacher for help?

More Details

🔵	1 - not likely at all	3
🟠	2	1
🟢	3	5
🔴	4	4
🟣	5 - extremely likely	1
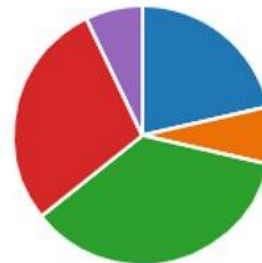
Harlow - Pre-test

How likely are you to ask another student or your teacher for help?

More Details

🔵	1 - not likely at all	6
🟠	2	18
🟢	3	24
🔴	4	24
🟣	5 - extremely likely	8

Harlow – Post-Test

How likely are you to ask another student or your teacher for help?
More Details

🔵	1 - not likely at all	9
🟠	2	11
🟢	3	28
🔴	4	18
🟣	5 - extremely likely	8

USP – Pre-test

5. Please tick the top 3 things that you find most helpful:
More Details

🔵	Personalised feedback	10
🟠	The ability to go back and ma...	10
🟢	Independent study (within les...	4
🔴	Managing your own work	2
🟣	Revision in your own time	8
🟤	Feeling comfortable	5
🔴	Other	0
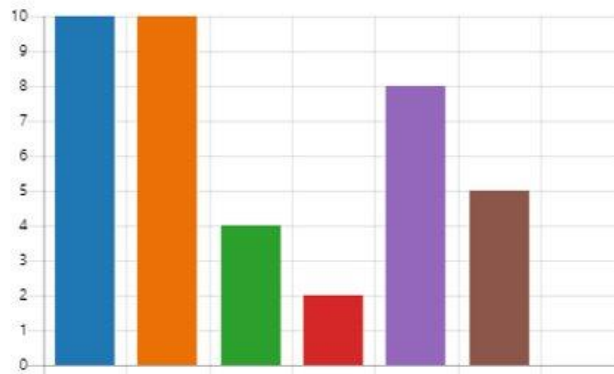
Harlow - Pre-test

Please tick the top 3 things that you find most helpful:
More Details

🔵	Personalised feedback	46
🟠	The ability to go back and ma...	36
🟢	Independent study (within les...	35
🔴	Managing your own work	26
🟣	Revision in your own time	31
🟤	Feeling comfortable	38
🔴	Other	3
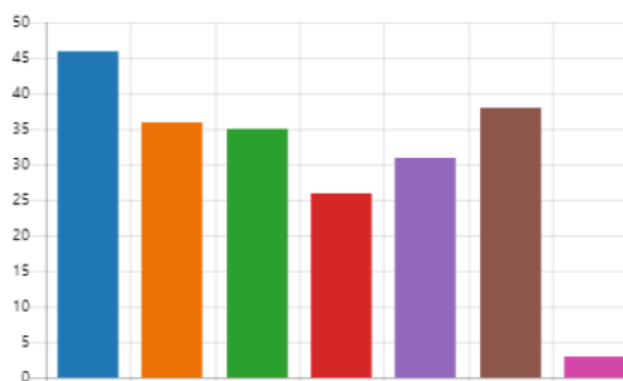
More interestingly, when asked for the top things that are most helpful, learners said personalised feedback, ability to revisit topics, and independent studies within lessons.

We are therefore planning to schedule, extra sessions 9 am to 10 am and 4pm to 5pm as revision (optional booster sessions) as spending the last 10 mins of lesson time for learners to work on their individual difficult topics.

In interviews with students about their experience on using Blutick, most learners said that they found Blutick easy to use in general, they liked the videos which are straight to the point and the fact that they can listen to another person explaining the concepts. However, there were recurring technical issues which made it very frustrating. One learner said for example: "It has been a bit buggy, sometimes it doesn't work in app or website. I completed an activity and it said I hadn't finished it", But when the technical issues were not there, they found it a useful tool to revise and practice topics.

However, in general, the students didn't like trying to learn a new skill independently, hence they didn't really complete the homework that was set to them on Blutick as part of flip learning. Some learners said that they forgot it was there when they were doing independent study and used it only when instructed and said that they preferred Corbett maths instead. Although Corbett maths wasn't the chosen platform for the research, it still served the purpose as what we wanted to know was whether learners can work independently using technology. Learners requested that a reminder be sent to them during the week, perhaps a text or email, to encourage them to make better use of Blutick.

Learners were also asked the direct question 'does Blutick help motivate you to do more maths outside of lesson?' All learners said yes, it does and that it makes them want to try more questions in the topic of interest, during their free time because it is more accessible and easier to use than paper. "I like the digital aspect of it. Though learners gave this answer, it appears that they were saying what they think we want to hear because we were not seeing the work that they did independently to back up their answers.

So, we followed up with the question like 'what would motivate you to use Blutick more?' They didn't really have much to say except that there needs to be an incentive, some form of reward for those who complete the work or if you do it in class you get to go home early.

Since we were trying to find out what time would be suitable for the learners to complete the task set, we asked learners whether they would like Blutick to be a part of their lessons and when would it be suitable for them to use it? We had mixed responses, some saying that it is best to set homework for them to do at home, because in class people work at different paces, so slow learners may not finish on time and if the faster learners are asked to go, the other learners will rush it and not do it properly. At the same time learners acknowledged that not many learners with do the homework. Some suggested that Blutick be used during the last 20 mins of the lesson and the incentive is that those who finish early will go early.

Some learners said that a demonstration of how to work through the questions would be helpful as well as being shown how to enter answers, because sometimes they enter correct answers but the answer is marked wrong due to wrong format. The teachers therefore decided that Blutick be used during the last 30mins of the lesson. Teachers were able to spend 10 mins demonstrating the use of Blutick and then ask learners to complete the set task in the last 20 mins whilst their teachers supervise.

Therefore, we concluded that Blutick didn't help with the independent learning that it was aimed at. Maybe if it is adapted to give instant feedback with features that enable teachers to see what they learners are doing live, in order for teachers to give learners the feedback that they need, then Blutick might be more effective and efficient.

When teachers started using Nearpod, and when learners were asked how they found the use of Nearpod? Most learners said that it provides more of a classroom feeling because the teacher can see what they are doing. It motivates them to do a good job because they have to show they know what they are doing, making them more of accountable, and also owning their work. Another good feature is that Nearpod allows learners to show their workings in real-time giving the teacher the opportunity to follow learner's thought process which in turn enables the teacher to give informed feedback. Learners said that Nearpod is better than Whiteboard.fi which is another platform that was experimented. They liked the fact that the teacher could give them that instant feedback.

A few learners said that they liked Nearpod because it was more interactive, and they were able to 'do' rather than watch. Some said that if they were going to use it, they would prefer using it in class because they didn't know how it will help them with their revision.

When asked whether Nearpod has helped to improve their engagement in lessons or motivates them to do more work independently, they said that it does, and that having Nearpod will "catch out" students that are not listening or paying attention. One of them said that "I enjoy drawing and using different colours and because I enjoy it, I'm more likely to do more outside of lessons". Another learner said that "Yeah, it does help, I could just be watching tv but Nearpod means I have to listen". A follow up question if they would like the use of Nearpod more or less often? Learners said that they will like it used more often even in the face-to-face sessions since the teacher can see what everyone is doing quicker and hence it can speed up general feedback. They were happy to use it because it enables them to show their working reducing guess work, however, the downside would be issues with iPads and networks. For example, one of them said the following:

> "Nearpod could be used for independent work and showing students' work on the screen. Although assessments are better on paper. The matching cards activity is good because you can see how many goes people take and if they are guessing. There is a good balance, and we should carry on using Nearpod".

However, following teachers' reflections, learners were asked to complete as many questions online in preparations for their exams, and the results are shown on the graph below

Number of Questions (on Blutick) vs Grade
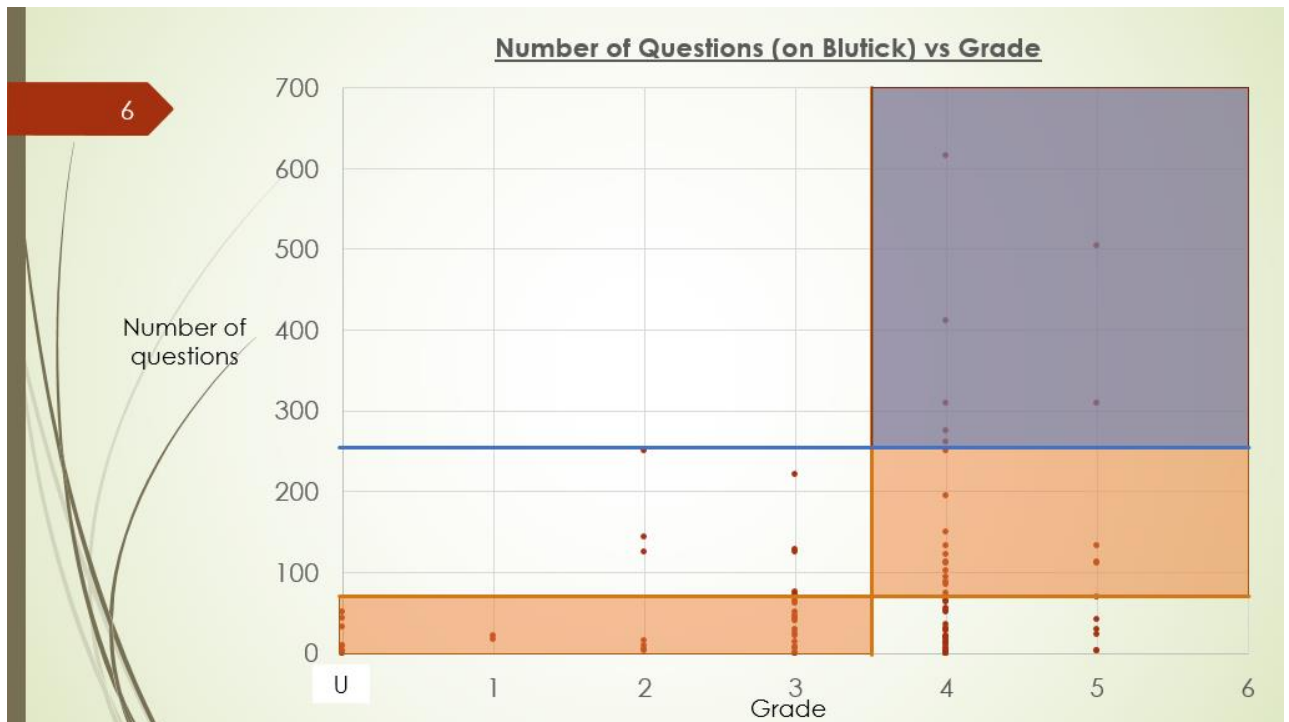
These results showed that the learners who answered above 250 questions certainly improved their grade. Those who answered below 90 achieved a grade 3, and those who answered between 90 and 250 were more likely to achieve a grade 4, this confirms that the finding by Suh, J. and Moyer, P. S. (2007), where they found that online platforms enhances learning. For this reason and in conjunction with teacher reflections we are going to continue to encourage learners to use online platforms to revise for their exams. There is clearly a positive correlation between usage and outcomes and engagement.

We asked learners if there are other websites/technology that they think we could use in Maths that are not being used currently? They named Kahoot because they like to compete against their mates and BBC bitesize was also mentioned.

It is worth noting that USP college used Nearpod as well as DESMOS and Kahoot and found similar responses, when used within the classroom most learners were engaged but when used for homework, they found that learners were reluctant to complete the tasks.

Conclusion and Recommendation

The students have experienced failure in Maths in the past and this has led them to see Maths as just a requirement for further studies or job prospects. They are not willing to spend their free time learning more maths and when they do, as soon as they face a challenge, they give up very easily. They lack any motivation to enjoy the challenge of tackling more 'difficult' problems.

From the replies from both the survey and interviews, we can see that only a small number of students are prepared to ask for help or do some independent work. The responses to which topics they find difficult, we were able to identify topic areas that they struggle with. Ratio and algebra (indices, solving equations etc) stand out as their most difficult areas, these results have been shared with all colleagues and the planning for next academic year will take this into account. We hope to teach more of proportional reasoning to encompass many topics and promote more dialogue approach.

Although it is difficult to draw meaningful conclusions from this research, because of poor attendance, which meant that different learners were present at different times during the research, we think that we are going to continue with the use of Nearpod, DESMOS and Kahoot. We know that with time learners will come to appreciate it and also teachers will become better at it and will know how to keep a target group of learners so that they can follow up responses.

We plan to conduct further action research on Mathematical Growth mindset for both staff and learners and the assessment of the positive growth mindset will be independent learning using technology. Since Nearpod is not a mathematical tool we will work with college through the Whole College Approach strand of the next year's CfEM programme and encourage the use of Nearpod within other departments so that the uptake would not just be for maths but for other vocational courses. At USP colleagues are keen to carry on with the use of DESMOS both in the maths department and in their vocational courses. Both colleges intend to continue to use various online platforms within their lessons going forward. In future, we will work together with USP to compare the effects of different platforms on engagement and achievement. Where learners at USP use DESMOS, those at Harlow use Nearpod and maybe a control group.

The biggest challenge is the students' motivation early in the academic year. Further research is needed on ways of motivating students to use technology outside of lessons (or introduce technology in lessons) so one of our focus from Sept 2021 is on Growth Mindset. We find that Students are willing to use technology (last 5+ years at least at HC) but lack in confidence, so we hope that Century will be an added advantage. Form the experience with Nearpod it is clear that learners want instant reward/impact/feedback. We may need to help them to be more resilient amongst others.

Suggestions:

We would suggest that:

- All learners use Blutick for at least 1 hour a week
- Teachers use Nearpod and white board function to practice maths problems
- Learners are rewarded for completing homework.
- Findings are communicated to students, so they know there is more chance of passing if they answer more than 250 questions.

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Appendix A

Name: ....

Questionnaire

Answer the questions below **honestly**.

Question 1.

1. Which college do you attend?

   USP

   Harlow

   Northampton

   Colchester

   (As a dropdown)

2.

Tick one box per row. 1= not at all. 5 = very much

	1 Not at all	2	3	4	5 Very much	I don't know
a. How much do you **enjoy** your maths lessons?						
b. How **difficult** is maths for you?						
c. How much of your maths lessons do you **understand**?						

you do you enjoy maths lessons?

Which topic do find hardest or most challenging?

(Mark - List Topics here and ask them to tick their favourite topics)

Which do you find simplest?

(Mark - List Topics here and ask them to tick their favourite topics)

Which have been your least favourite topics so far?

How do you find the use of Blutick?

How much time do you spend using technology (Blutick, Century, other) to help with your maths?

Your teachers want to hear your ideas for making maths lessons better for you. Please identify something that will improve your maths lessons.

Please indicate the top three things do you find useful?

Personalised feedback
The ability to go back
Independent study
Managing your own work
Revision in your own time

Appendix B

1. What types of things have you done when you have been in the Maths Lab?

2. How has the Academic Coach helped you?

3. What do you think are the benefits of going to the Maths Lab?

4. What would you say is the best thing about the Maths Lab?

5. What could the Maths Lab do better?

6. Have you learned any skills that you have been able to use in your lessons?

7. Has the Maths Lab made you feel more or less confident in class?

8. Do you think you have learned any life skills that you will be able to use in the future?

Appendix C

Q1) How have you found using Blutick this year?
Jayden "It's okay it hasn't really done much"
Millie does not like how the app has level 1, level 2 questions then the quiz. She prefers more questions and differentiated like BSG.
Kenneth found using Blutick was rather easy and it is helpful with the stuff that it provides the questions and videos
Sadi agreed with Kenneth
Isaac Found Blutick okay

Q2) Has Blutick helped you improve your maths?
Johnny "A little, it starts off easy and it works itself to harder questions"
Jayden "It went back over the question"
Tariq said it has different methods to solve the equation which he likes.
Millie said yes because it has different levels of difficulty
Isaac personally he prefers Nearpod with those kinds of questions.
Sadi Blutick helps me understand the content better
Kenneth helped with the wording of sort of questions like ratio

Q3) Does Blutick motivate you to do more maths outside Lessons?
Johnny "Yes if it's a subject that I don't particularly understand"
Millie "Yes and no. When you set a task and I will finish it gives you more maths to do and if I don't like the topic I will just not do it"
Sadi said she don't think so.
Kenneth" yes I guess not really sure"
Isaac slightly

Q4) What will motivate you to use Blutick more?
Johnny "If it had a couple more questions broken down easier"
Tariq "It's more fun to do maths in the Blutick app"
Sadi "If we were told to do it in the lesson that would motivate people to do the work

Q5) When should Blutick be used?
Jayden "Used for homework, were you can continue with the work after"
Jonny "You can use it in the middle as well as homework "
Tariq said a mixture of both beginning, in the middle and homework
Millie said she would prefer it as homework because you don't have a time limit to do the work by.
Sadi said it could be done when ever
Isaac in the middle or the end

Q6) How have you found using Nearpod in the last 2 months?
Billy "Good. Like the fact you can see my answer and you can tell well I am struggling or not"
Joseph said he liked using Nearpod because the teacher can see everyone's answers and address any problems.
Kenneth said it is rather easy to use which is good
Sadi agreed with billy
Isaac enjoys the instant feedback

Q7) Has Nearpod helped you improve your engagement in lessons?
Johnny "Yeah, If I get stuck on a question I can ask you and you can go straight to the question I am having problems with."
Jayden "Yes it can but it can be a bit frustrating when you have to move on because of time"
Mille thought that it did because the teacher can see where the student is making mistakes and immediately correct them.
Joseph agreed
Sadi you go through the whole questions with us
Isaac feels it has improved his engagement
Kenneth quite enjoys it

Q8) Does Nearpod motivate you to do more work inside/outside Lessons?
Johnny "Yes it helps cause if they do work outside lessons they can always send it to the teacher to check"
Billy "I don't think it does outside lesson but inside it does"
Joseph yes it does because you give us a code and we can do the work
Sadi it motivates me to do more inside lessons because the teacher can see what I am doing and you can be asked to do more if need be
Isaac more inside lessons
Kenneth inside as well

Q9) Would you like Nearpod or similar websites to be used more or less inside the lesson?
Johnny "Less often, on easy question it doesn't really help much but you can use it on harder questions"
Billy "Good little mix, just the right amount"
Joseph I would like it to be used in more lessons.
Kenneth, Issac and Sadi said "More Often "

Q10) Are they any other technologies we could use in maths that are not being used currently
Jayden "Maths watch because it has videos that you can use that show you how to calculate questions.
Tariq said Maths watch shows you how to do it by using videos.

1.Which college do you attend?

O Harlow (or STAC)

O USP

O Northampton

O Colchester

2.How much do you enjoy your maths lessons?

O 1 - not at all

O 2

O 3

O 4

O 5 - very much

3.How difficult is maths for you?

O 1 - not difficult at all

O 2

O 3

O 4

O 5 - very difficult

4.How much of your maths lessons do you understand?

O 1 - not at all

O 2

O 3

O 4

O 5 - very much

5.How likely are you to spend extra time doing maths outside of lessons?

O 1 - not likely at all

O 2

O 3

O 4

O 5 - extremely likely

6.How likely are you to ask for extra work?

O 1 - not likely at all

O 2

O 3

O 4

O 5 - extremely likely

7.How likely are you to ask another student or your teacher for help?

○ 1 - not likely at all

○ 2

○ 3

○ 4

○ 5 - extremely likely

8.What do you enjoy the least or find most challenging about maths lessons?

[   ]

9.What would make your maths lessons more enjoyable?

[   ]

10.What has been your favourite topic so far?

○ Number - Fractions/Decimals/Percentages

○ Number - Factors & Multiples

○ Number - Indices & Standard Form

○ Algebra - Expanding & Factorising

○ Algebra - Solving Equations & Inequalities

○ Algebra - Sequences

○

[   ]

11.What has been your least favourite topic so far?

○ Number - Fractions/Decimals/Percentages

○ Number - Factors & Multiples

○ Number - Indices & Standard Form

○ Algebra - Expanding & Factorising

○ Algebra - Solving Equations & Inequalities

○ Algebra - Sequences

○

[   ]

12.How much time do you spend on Blutick per week?

○ I have not used it

○ I use it for less than 30 mins per week

○ Between 30 mins to 1 hour per week

○ Between 1 hour and 2 hours per week

○ 2 hours or more per week

13.Provide some feedback on how helpful you have found Blutick.
(If you have not used, please type "N/A")

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14.Your teachers want to hear your ideas for making maths lessons better for you.
Please write down your ideas here.

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┌────────────────────────┐
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15.Please tick the top 3 things that you find most helpful:

☐   Personalised feedback

☐   The ability to go back and make changes

☐   Independent study (within lessons)

☐   Managing your own work

☐   Revision in your own time

☐   Feeling comfortable

☐

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Appendix E

Comments on Blutick

- Learners found Blutick easy to use in general. Some had recurring technical issues and found it frustrating.
  "I found using Blutick was rather easy and it is helpful with the stuff that it provides the questions and videos."

-

- Learners found it useful to revise and practice topics, but didn't like trying to learn a new skill independently (e.g. as homework) on Blutick.
  "When you set a task and I will finish it gives you more maths to do and if I don't like the topic I will just not do it."

-

- Some learners said they forgot it was there when they were doing independent study and used it only when instructed, choosing Corbett math for example instead.
  "If we were told to do it in the lesson that would motivate people to do the work."

- When should we use it?
  "Used for homework, where you can continue with the work after."
  "I prefer it as homework because you don't have a time limit to do the work by."
  "It could be done whenever."
  "In the middle or the end of the lesson."

- Has Blutick helped improve your maths?
  "A little, it starts off easy and it works itself to harder questions."
  "Blutick helps me understand the content better."
  "It has different methods to solve the equation which I like."
  "Personally I prefer Nearpod with some kinds of questions."

Comments on Nearpod

- Learners liked Nearpod because it's interactive and they were able to 'do' rather than watch.

  "Good. I like the fact you can see my answer and you can tell when I am struggling or not."
  "It is rather easy to use which is good."
  "I enjoy the instant feedback."

- Learners said they were OK with using it in lessons, but didn't know how it could help them with independent revision.

  "Yeah, If I get stuck on a question I can ask you and you can go straight to the question I am having problems with."
  "It has improved my engagement in lessons."
  "It motivates me to do more inside lessons because the teacher can see what I am doing and you can be asked to do more if need be."
  "I don't think it does outside lesson but inside it does motivate me."