

Introducing blended teaching and learning opportunities through the use of interactive maths software

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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.

Summary

This action research project considers the implementation of blended learning through the use of interactive maths software. The action research was designed to measure the impact of such software on learners and how it might change their perception of GCSE maths.

Data was collected through two student surveys, one in October 2020 and the second in March 2021 with the participation of approximately three hundred and fifty students.

Monthly tutor reflections from eleven participating tutors also offered insight into how students adapted to the software throughout the academic year.

Results from the two surveys implies that student confidence in their maths skills increased to varying degrees and that student confidence in using computers and the interactive software increased between the two time frames, regardless of the type of software utilised.

Data also suggests that subjects that students found challenging were common across all participating colleges with little variation between October 2020 and March 2021.

The project suggest that though interactive software can be of benefit to students and tutors, successful implementation and a balanced delivery of maths will ensure more effective engagement and participation.

Also, the regular reviewing of maths subjects is essential throughout an academic year to support students to develop their knowledge and confidence in working through parts of GCSE maths that learners highlighted as requiring more support specifically fractions, ratio and algebra.

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Background

As part of the action research development for 2020-2021, the Stamford College network partnership has focussed on the Data and Technology and Mastery themes with an action research focus on the introduction of elements of blended learning in maths teaching.

It is acknowledged that while the research focus on Mastery is new, the network has chosen to continue from last year the development of incorporating technology software into the teaching and learning of GCSE maths.

The network is made up of ten establishments with six involved in the action research project including Stamford College. There were approximately twenty GCSE maths lecturers in total with eleven GCSE maths lecturers involved in the action research teaching a cohort of approximately three hundred and fifty students in the project overall.

College goals and wider context

There are a variety of wider contexts that were considered that influenced and impacted the shape of the action research project and these included the requirement to focus on a minimum of one of the Centres for Excellence in Maths Core Themes of Activity:

1. An adapted mastery approach to mathematics
2. Approaches to contextualisation which relate maths to real-world situation
3. Motivating and engaging learners,
4. The use of data and technology within mathematics education in the sector.

Equally Stamford College aims to respond to key quality improvement targets from the college SAR which is to "...continue to embed a range of learning activities to further enhance independent learning e.g. using blended learning, flipped learning & collaborative learning using IT."

As well as the key factors above, the research team had to consider the three strands of activity as proposed in the CfEM Technology and Data theme, each of which directly relates to the teaching and learning of maths.

Research aims and objectives

The Stamford College maths partnership action research team chose to introduce the Mastery theme alongside the Technology theme. The action research team aimed to introduce blended teaching and learning opportunities through concepts of Mastery and the use of technology (interactive maths software).

The research opportunity brought together five partner colleges to work with Stamford College to take part in the action research project. The partnership consists of Stamford College, College of West Anglia, Peterborough College, City College Peterborough, Grantham College and Moulton College. Each college utilised maths software appropriate to their setting and cohort to use and develop as part of the blended learning explorative research.

The main quantitative research tools used to gather responses to the research trials are student surveys conducted during two windows of research – October 2020 and March 2021.

Information and trends from student and tutor comments as well as ongoing monthly reflections has formed the main qualitative part research data from both students and tutors.

The data gathered will look at the impact of the blended learning approaches pre and post-trial activities and review how students and tutors have adapted throughout the academic year.

The blended learning opportunities have allowed for greater analysis of student understanding at concept level, considered the potential to offer greater personalised learning and opened up further opportunities to identify intervention needs and increase opportunities to engage and motivate students in maths.

Literature Review

Background and context

The history and use of IT hardware and software in the teaching of the mathematics curriculum in the English education system is a key element to the backdrop of the development of this project due to the slow progress of the integration between the two. The potential of digital software as a tool to improve achievement for students in Further Education has significant opportunities.

The government commissioned the Cockcroft Report (1982) which looked at the teaching of mathematics including a review of the potential for computers to become an integral part of teaching of secondary mathematics. Interestingly the Cockcroft Committee referred to computers as providing opportunities for enhancement of teachers' existing practice and yet at the same time highlighting there was under-use of technology in schools and lack of good quality mathematics software as highlighted by Cockcroft (1982)

It is almost 3 decades between the Cockcroft and Curtis reports highlighting similar potential barriers that need to be considered with the introduction of this action research project centred on blended learning. The "under-use of technology in schools and lack of good quality mathematics software" can still be identified as key issues in the teaching of maths in Further Education which has been predominantly focused on traditional classroom taught sessions. This angle is again supported in reports such as those written by NCETM (2010) and Office for Standards in Education (Ofsted 2008) which highlighted the lack of use of digital technology in mathematics classrooms. Curtis (2019) again supports this view as he considers that Government control of the curriculum and examinations has been increasing with little focus on using digital technology in secondary mathematics curriculum or examinations.

Another important element that has been identified as key to the success of using technology in the classroom is the teacher's skill set as identified in the McKinsey Report (1997) which stated: "There is evidence that many teachers lack the training, support, communications and therefore proficiency to be fully effective in the use of IT" McKinsey & Company (1997). This theme still continues in later articles such as Benning, I. et al (2018), some 20 years on, that identifies "teacher disposition towards ICT is very positive with strong belief about the importance of ICT in the classroom...limited knowledge, skills and time, the teachers found difficulty implementing ICT in ways they had hoped." While Curtis (2019) identifies that without support, training and raising of the digital technology profile in curriculum and examinations as a teaching aid, progress will continue to remain constrained and in addition, Preston et al (2000) also reported on the breakdown of equipment acting as a disincentive to using digital technology.

Managing action research

Whilst there are key barriers to consider and manage within the action research project, such as working with software and hardware limitations and reduced opportunities for staff development, it is important to acknowledge that digital technology plays such an important role in modern life and that it is imperative to showcase it to both students and staff so as to give the message that mathematics does use digital technology. The benefits to using digital technology are identified by Choi-Koh (1999) who showed how technology, particularly Geometer's Sketchpad (GSP), moved a student's learning of geometry from one level of understanding to the next in rapid succession and Moses & Cobb (2001) saw technology as the great equalizer especially as technology was an inevitable consequence of changing times.

To reinforce the importance of the focus of this action research project, Cheung et al (2013) state that with seven major reviews on education technology used in mathematics teaching the majority concluded that there were positive effects on student achievement in mathematics. Therefore, it is essential to use this opportunity to establish the use of digital technology as an important part of mathematics teaching in Further Education.

It is also important to consider the framework within which maths and educational technologies are established. It is common to consider technology-based lessons in isolation, a small element of a student timetable. Yet the skills being developed through interaction with such technology is highly transferable to employment and further studies. As Dabbous & Emms (2020) highlight in case studies with four colleges, students engaged in technology that was linked, or at least adapted, to their vocational subject. This synergy was deemed key for student engagement and long-term development by allowing students to use technology to make mathematical connections.

Consistency of support and the development of staff confidence in technology was also cited as a key influence for overall uptake. "Many lecturers would feel discouraged when the use of digital tools would go wrong, especially if this occurred in front of their students." Dabbous & Emms (2020). Such impact was twice as significant as both students and lecturers lost faith in the software and materials provided. Though there are ways to resolve the issue through dedicated training, it is key that "on-hand support is provided over the period of time necessary to ensure enough skill and confidence is developed by staff and students" Dabbous & Emms (2020).

With reference to blended learning in particular and how it forms a key basis of Stamford College's research, it is important to recognise that the term has evolved over time. Hrastinski (2019) explains that blended learning is an umbrella term and is used to "...describe other blends, such as combining different instructional methods, pedagogical approaches and technologies, although these blends are not aligned with influential learning definitions." Blended learning as a definition of a concept evolved through Stamford College's action research in 2019-20. For this academic year's action research, the term has defined itself further due to the actions and understanding of the maths team as well as other impacting factors such as the current Covid-19 pandemic. Hrastinski (2019) describes that there is "...general agreement that the key ingredients of blended learning are face-to-face and online instruction or learning."

The paper encourages Stamford College's action research team to review in detail their understanding of blended learning and create an agreed consensus. "It was suggested that researchers and practitioners should carefully consider whether using a more specific,

descriptive term as a complement or replacement to blended learning when appropriate” (Hrastinski 2019).

Such comments represent Stamford College’s approach to delivering maths this academic year in response to Covid-19. Digital uptake, or the advanced integration of technology has significantly increased as a result of the pandemic as the majority of students have not been able to access lessons on site. The action research also will consider how such knowledge and development can be sustained to shape future learning.

Learning opportunities

One key factor is how blended learning can provide bespoke learning opportunities to students. Stamford College renewed their licence with GCSEPod for a second academic year because feedback was positive regarding how students could choose their own path of learning. According to Attard & Holmes (2020), using digital technologies means that “...teachers can take advantage of the affordances of technology to vary instruction and provide student-controlled learning paths.”

Offering such independence to students can be a risk. Lecturers rely on students to access learning opportunities and work through them effectively on their own. However, though it could be considered that “...student-controlled learning paths may not be conducive to learning progress if left unmonitored, many contemporary educational apps also provide teachers with frequent formative assessment and progression data aligned to curriculum standards” (Attard & Holmes 2020).

Feedback from GCSEPod and Stamford College’s action research in academic year 19-20 that indicated the majority of students responded well to having the opportunity to access learning not just via a lecturer in a classroom. Students explained that they felt that their own specific needs were being addressed, which Attard & Holmes (2020) indicate, “Decreasing the need for whole class explicit teaching within every lesson allows the teacher to work more effectively to address the learning needs of individual students.”

Significant lessons were learned by the maths team in response to working with software and how applications could be integrated into lessons. Reflection is essential to identifying our strengths as a team and where there could be training opportunities. This also applies to students.

Covid-19 and online delivery

As a reaction to the Covid-19 pandemic and the UK lockdown in March 2020, Stamford College moved to an online delivery system within a matter of days. Though the teaching team were using elements of blended learning and digital resource, their knowledge was tested to the limit with the sudden change in delivery. Students also needed to learn and understand the altered teaching methods to fully engage in the learning process. Similar to a study by Attard & Curry in 2012 that explored the use of iPads to engage young students with mathematics over a six-month period, time was needed to trial software and adapt to the new delivery model. Attard & Curry (2012) observed that “...although it appeared all students were behaviourally and affectively engaged, not all were engaged on a cognitive level possibly due to a mismatch between their ability and the given task.”

The novelty of learning online can impact student engagement as adaptive learning took place. Students and lecturers both need time to adjust and upskill in order to teach or learn effectively. Indeed, as Attard & Holmes (2020) surmise, having unprepared students would result in unproductive classroom time.

Though barriers still present themselves this academic year, the lessons learned from March 2020 to July 2020 were essential in developing a programme of study for academic year 20-21. This process continues to be developmental and the maths team continues to build on their reflective practice.

Effective training and allowing time to review practice is essential for widespread adoption of online technologies and their teaching opportunities. This is certainly true of a digital environment that is constantly evolving at speed which also affects the role of the tutor. The NMC/CoSN Horizon report (Freeman et al. 2017) highlights the difficulties faced by teachers today:

Teachers now address social and emotional factors affecting student learning, mentor students, model responsible global citizenship, and motivate students to adopt lifelong learning habits. These evolving expectations are changing the ways teachers engage in their continuing professional development, much of which involves collaboration with other educators and the use of new digital tools and resources. (Freeman et al. 2017)

Through the Centres for Excellence in Maths initiative, Stamford College has been provided with those opportunities to empower teachers to use hardware and software in their classrooms, both on site and online. Freeman et al. (2017) claim that appropriate teacher training, continuous professional development, researching about student learning and teacher collaboration are critical for the improvement of teacher practice in this digital age.

Managing factors that impact such processes are key for continuous engagement from both students and teachers beyond this action research project. "The diversity in schools, classrooms, students, teachers and cultures means there can be no perfect solution for how teachers and students should use technology. Deciding what technology is best for specific students and cohorts and how to use it is a continuing challenge." (Attard & Holmes, (2020).

In conclusion, implementing technology in a classroom environment has always presented challenges. These include lack of resources, teacher reluctance (or lack of CPD) and the overall infrastructure of a college being unable to accommodate such a delivery method. The Covid-19 pandemic has altered the teaching and learning environment for managers, teachers and students, resulting in a forced adaptation. Through the action research it is planned that feedback can be captured to identify improved methods of delivery by reviewing software such as GCSEPod and capturing student feedback in a uniquely challenging period.

Methods

Research design

The project aim is to improve understanding of a range of the key most common concepts which students often struggle with in GCSE maths re-sits by introducing blended teaching & learning opportunities. The aim allowed a broad scope of research to take place with all the involved colleges, including the use of different interactive software to identify trends in both student opinion or teacher development.

Stamford College used GCSEPod as did City College Peterborough. Grantham College and Moulton College used Century, Peterborough College used Mathswatch and College of West Anglia used Learn, part of their Moodle platform.

Each college adapted the action research to their own environment. Stamford College delivered lessons online throughout the academic year and the intervention was asynchronous, allowing students to access resources before and after the lesson. The same applies to Peterborough College, College of West Anglia, Grantham College and Moulton College. The software was used prior to lessons to ascertain student knowledge but also allowed students post-lesson to continue their development through questions and activities that varied depending on the software used. City College Peterborough, due to the type of learners they predominantly work with used the resources synchronously as part of their onsite lessons.

Two research cycles were planned to demonstrate progression and change throughout the academic year. The first was for October 2020 and the second for March 2021. Each college shared two student surveys that resulted in both qualitative and quantitative data which students had the option to complete through an online form or on paper.

The data from both students and teachers will be used to evaluate the impact of interactive maths software as part of a blended learning approach and highlight any key findings that could support the delivery of maths in academic year 2021-22.

All students and teachers taking part in the two windows of research were informed of the process, that participation was voluntary and that they could withdraw from the planned activity at any time and any data they had provided would be removed from the data set.

Student data and responses and college settings have been anonymised and all information provided, either through paper-based completion or online submission has been stored securely.

Overall, there were 344 respondents to survey 1 in October 2020 and 296 respondents to survey 2 in March 2021. Unfortunately, we were unable to question the same students in both timeframes but the network ensured that a significant number of students were polled in both surveys.

Though Covid-19 has had an impact on data gathering, it has resulted in some valuable information that will shape the delivery of maths next academic year. The second cycle in March was disrupted with some students returning to classrooms for onsite delivery, though this did not apply to every college.

Results and Discussion

Student confidence in their maths ability increased in all 6 colleges from October 2020 to March 2021

The results indicate that student confidence in their own maths skills and ability increased from survey window 1 in October 2020 to survey window 2 in March 2021. All six colleges saw an increase in this measure with college 1 seeing the smallest mean difference increase of 0.03 through to college 6 with a mean difference increase of 0.52.

The graph and table below highlight the difference between October 2020 and March 2021. College 6, using the Moodle platform, had a lower score of effectiveness when compared to the other colleges in October 2020 but saw the largest increase of 0.52 points through to March 2021.

College 5, using GCSEPod, also saw a significant increase of 0.40 points between the 2 timeframes. However, college 5 scored a higher mean average of 3.14 in October 2020 compared to college 6's low score of 2.73 out of 5.

Colleges 2, 3 and 4 all saw similar positive increases (0.23, 0.26 and 0.25 respectively) while college 1, also using GCSEPod, had the smallest increase overall of 0.03 points from October 2020 to March 2021.

Cluster bar chart 1 to demonstrate change in average student confidence in October 2020 and March 2021.

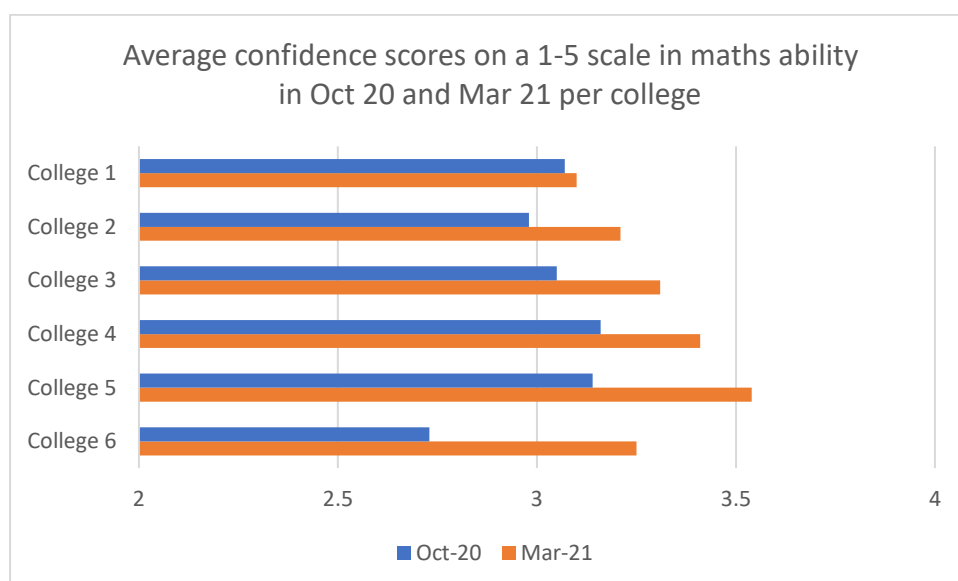


Table 1 to show mean average and difference per college of student confidence in maths ability in October 2020 and March 2021.

College	Mean average Oct 20	Mean average Mar 21	Mean average difference
College 1	3.07	3.10	+0.03
College 2	2.98	3.21	+0.23
College 3	3.05	3.31	+0.26
College 4	3.16	3.41	+0.25
College 5	3.14	3.54	+0.40
College 6	2.73	3.25	+0.52

Though this increase in confidence could be for a combination of reasons, it is interesting to note that across all six colleges there was an overall increase in student confidence in their maths ability.

Considering that during these two time-frames there was a second national lockdown announced in January 2021 with a complete movement to online learning as well as confirmation that GCSE maths exams were not taking place for a second summer, students overall, judged their ability and skills to have improved.

This could be representative of delivering a maths syllabus and the times at which the surveys were completed. However, if the method of delivery has been online or via the use of computers and interactive learning software, it could be that the hardware and software played a part in developing that confidence.

Comments from the students between both windows also highlights an increase in maths confidence. As one student from college 2 explains, 'Mathswatch...has made me more confident with maths as I used to struggle with my confidence doing answers but the online lessons and software help me understand more easily (Student 1 response – college 2).

Another comment from a student from college 3 provided insight into developing confidence '...I use my own initiatives and skill to do the answer, I'm independent in my own study and gain this confidence on my own as well.' (Student 1 response – college 3)

A college 1 student also explained how their increased confidence has changed how they work in maths lessons:

'Learning online has increased my confidence in using computers and everything is in one place which makes it easier to revise and it is easy to find them. I don't need hard copies anymore.' (Student 1 response – college 1)

Though the software and maths lessons worked well for some student learning styles it needs to be highlighted that there are students that found their confidence decreasing throughout the academic year for various reasons. Some students cited complexities in engaging with online learning due to barriers to accessing hardware.

Other students expressed concern that teacher assessed grades would be used instead of having the opportunity sit an exam in summer 2021. After receiving a centre assessed grade in summer 2020, many students felt they received a grade not reflective of their ability. Several student comments expressed concerns that the same would occur this year which could impact their confidence in the subject.

A student from college 1 commented from the October 2020 survey that their confidence in maths was reasonable but ‘...working on computers all the time away from college is difficult because of the lack of motivation and confidence’ (Student 2 response – college 1)

A tutor from college 3 summarised in a reflection how they observed some students fall in confidence throughout the academic year:

Online learning with live teaching is not suited to all students. Some enjoy the pace of the session and find it less pressurised to work through questions at their own pace. Some find it challenging when they are balancing family life and a poor wifi signal along with their learning. This lowers their confidence in their ability. Opportunities for asking questions were more challenging even though the chat function was used. (Tutor response 1 – college 3).

Similar comments are found through the tutor reflections from all colleges, indicating an awareness of the barriers faced by their students accessing maths. Similar comments also echo the fact that a balanced delivery of maths has the highest potential of engaging the majority of students.

Consequently, though the data has shown an overall increase in confidence, it is key to be aware that student confidence has been impacted for a variety of reasons and there are many factors that can influence how a student feels about maths.

Student confidence in using computers to learn maths increased between October 2020 and March 2021 at all 6 colleges.

Though it was expected that the majority of students would be proficient in using computers the survey indicates that even in October 2020 all six colleges report an average student confidence in using computers to learn maths of at least three out of five.

When the question was repeated in the March 2021 survey the results indicate that students have adapted well to using computers to learn maths with increases in the mean average points at all six colleges.

The smallest increase in confidence is with college 1 with a mean average increase of 0.12 points. Colleges 2, 4 and 6 saw a mean average difference of 0.69, 0.70 and 0.89 respectively.

Cluster bar chart 2 to demonstrate change in average student confidence in using computers to learn maths in October 2020 and March 2021.

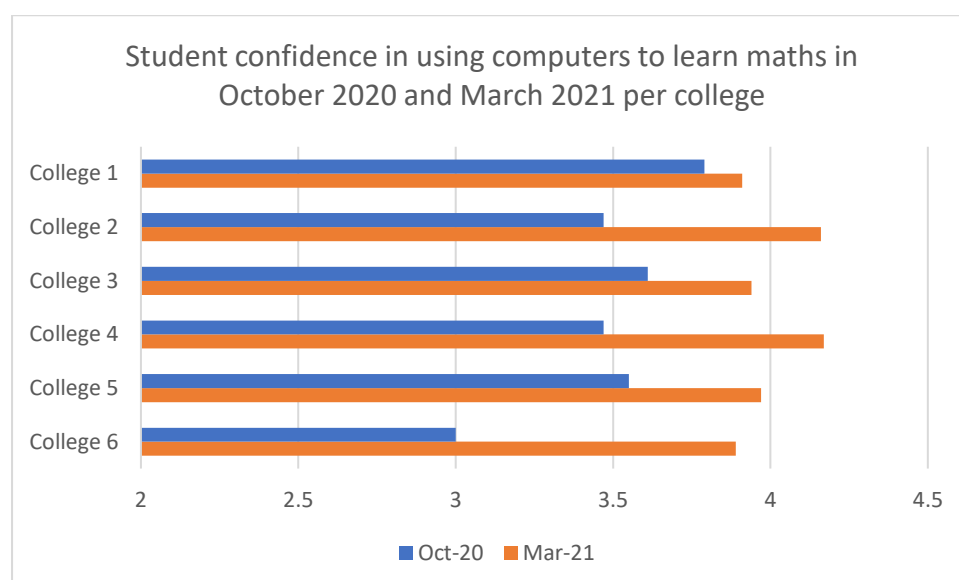


Table 2 to show mean average and difference per college of student confidence in using computers to learn maths in October 2020 and March 2021.

College	Mean average Oct 20	Mean average Mar 21	Mean average difference
College 1	3.79	3.91	+0.12
College 2	3.47	4.16	+0.69
College 3	3.61	3.94	+0.33
College 4	3.47	4.17	+0.70
College 5	3.55	3.97	+0.42
College 6	3.00	3.89	+0.89

Equally, a draft hypothesis at the start of the project was that the majority of students would be frustrated with online learning software and the ongoing uncertainty around maths delivery (and the wider context of Covid-19 in general). This could be compounded by low quality experiences of maths software from the first lockdown in March 2020 when many educational institutions had to rapidly adapt to some form of online delivery to work towards the calculated grades process.

It is therefore somewhat surprising that the majority students, even in October 2020 were demonstrating confidence in using computers to develop their learning of maths.

Such development in confidence can be seen in the tutor reflections as well. As one tutor from college 6 commented in a reflection from November 2020:

‘There has been a definite improvement in the confidence of all of us to teach online although we have, in general, kept it pretty simple to start off with. There are students out there who have to share very limited digital resources and bandwidth.’ (Tutor response 1 – college 6).

This echoes research and readings from the literature review that it does take time for both tutors and students to learn and understand the software and that to develop best practice and implementation takes time. Equally for students, it is a learning process to adapt not just to online learning but also the software that each partner used.

The monthly reflections from the tutors involved also highlight the learning curve they themselves faced regarding understanding the software before rolling out across their classes. This evolution took place over the academic year. As the team developed their knowledge of the software and identified strengths and areas for development, they could support their students more effectively.

This could explain how the mean average confidence in using computers to learn maths has increased across all colleges and implies that good training and development was implemented to support both tutors and students in maximising the potential of the software.

The data implies that college 6 went through a significant transitional period between October 2020 and March 2021 that resulted in 0.89 mean average increase, further research is planned for academic year 2021-22 to identify and develop best practice.

As one student explained '...it has made me realise that having a time plan which keeps me on track and motivated is very important because no one is there in real life to do it'. (Student response 3 – college 1). This is an example of successful adaption but not every student will be able to adapt so rapidly.

For example, a student from college 5 mentioned '...it has made me less engaged with the work and has made it slightly different to interact with the teacher when having a query.' (Student response 1 – college 5).

Another student explained their learning environment was not suitable, which impacted their judgement of the software. 'I get migraines from looking at a screen too long also I'm at home which is a place for me to relax not a place to do college work. I prefer to be in a classroom doing it.' (Student response 1 – college 4)

Such comments indicate that a blended learning approach where both onsite and online delivery could provide a balance that more students could adapt to. Overall, the comments are polarised with the majority of students feeling either positive or negative about using computers to learn maths. Very few students did not have an opinion or felt there was no change in how they accessed maths.

The intervention of interactive software was judged effective by students at all 6 colleges – increasing in the second survey in March 2021

The feedback from the survey highlights that between the two timeframes of October 2020 and March 2021 the perceived effectiveness of the interactive maths software increased. College 6 saw the most significant increase with a mean average difference of 0.35 points, closely followed by college 3 a 0.34 point increase.

Though some increases in student confidence were slight (0.02 for college 5), it is again interesting to note that across all six colleges taking part in the project, regardless of the type of maths software used, students have judged the effectiveness of that software to have increased between the timeframes of October 2020 and March 2021.

The graph and table below demonstrate those increases in confidence and that the mean average for all colleges was over 3 in the March 2021 survey.

Cluster bar chart 3 to show mean average and difference per college of student judgement of effectiveness of interactive maths software to learn maths in October 2020 and March 2021.

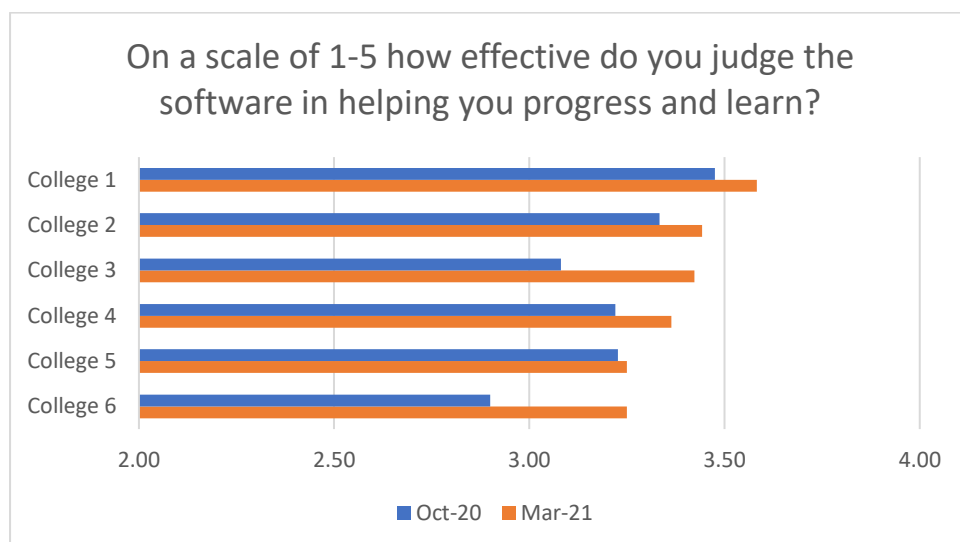


Table 3 to show mean average and difference per college of student judgement of effectiveness of interactive maths software to learn maths in October 2020 and March 2021.

College	Mean average Oct 20	Mean average Mar 21	Mean average difference
College 1	3.48	3.58	+0.11
College 2	3.33	3.44	+0.11
College 3	3.08	3.42	+0.34
College 4	3.22	3.36	+0.14
College 5	3.23	3.25	+0.02
College 6	2.90	3.25	+0.35

There could be several reasons for this ranging from colleges adapting to the nuances of the software, improved incorporation into delivery and lessons as well as students and tutors developing the more advanced aspects of the software.

A thoughtful comment from a college 4 student reflects the data. 'Having face to face lessons is still the best way to learn...however I find it really easy to understand doing online software. If I don't understand something I just watch it all over again or do research myself until I understand and less pressure as well.' (Student response 2 – college 4).

A different student from the same college commented 'I am hoping that you mean the Century learning system, that we have access to from the college, I find it brilliant in both learning and revising.' (Student response 3 – college 4).

Many students comment on the videos within the interactive software and that it supports independent learning 'the software for example...is very helpful with the videos explaining make it clear and it all set out nice and simply making it easy for me to answer my questions without getting confused.' (Student response 1 – college 6).

Again, many comments from students refer to taking ownership of their learning of maths. One student from college 2 explained that the software (in this case Mathswatch) was excellent at introducing a topic and allowed them to prepare for their 1-1 support session with a tutor. That student could plan their learning to suit their own needs.

However, similar to other findings presented, many students faced barriers with their interactive software that resulted in them judging the technology as not being supportive or requiring additional support from a tutor.

Comments ranged from the software itself, such as work not being saved, server and password issues to not having the hardware or internet bandwidth to access the software effectively and regularly.

The most common element that students raised in both surveys was that the software could not replace the bespoke support a tutor can offer in a classroom:

I have found it extremely hard with doing work with maths it's not been the same as it is when it comes to face to face learning you know exactly what you need to do and where you go wrong when your online you're not sure if you're doing the work correctly. (Student response 4 - college 4).

It is apparent that a network of support is required for learners to engage with interactive software and develop their own confidence. Some students can adapt rapidly and make the delivery work for their learning styles. Other students require nurturing, training and encouragement to engage which reflects how tutors would aim to deliver maths either online or onsite. The challenge is having the time to effectively launch such an intervention and effectively embed.

Topics that students felt they required support in are common across all 6 colleges and there is little variation throughout an academic year (October 20 to March 21), though frequency of topic changes.

The tables below summarise the top 5 topics per college that students identified as requiring support in. The data is split into the two survey periods of October 2020 and March 2021.

Within each timeframe there is little variation in the top five topics but it is interesting that fractions are the most frequent choice for five out of six colleges and the second most selected for college two in the data from the first survey in October 2020.

Ratio and algebra also feature in the top five topics for each college which suggests that at the start of an academic year fractions, ratio and algebra are prevalent in the minds of our students.

This could reflect missed learning opportunities at secondary school or college or be the most common subjects that students associate with maths or exams.

The second table (March 2021) constitutes of the top five topics students felt they required support in toward the end of the teaching syllabus. Again, fractions and ratio feature in the data sets of all six colleges with algebra also prominent in five of the six colleges.

Tables 4 and 5 to demonstrate most common subjects identified by students that they would like support with in October 2020 and March 2021.

Oct-20																	
College 1 (Total)		172	College 2 (Total)		152	College 3 (Total)		52	College 4 (Total)		98	College 5 (Total)		32	College 6 (Total)		38
Fractions		39	Algebra		26	Fractions		10	Fractions		19	Fractions		8	Fractions		9
Ratio		32	Fractions		18	Ratio		7	Algebra		16	Metric		5	Ratio		8
Algebra		22	Ratio		18	Angles		7	Decimals		11	Decimals		3	Division		6
Percentages		12	Angles		13	Percentages		4	Percentages		11	Ratios		3	Algebra		4
Angles		10	Percentages		12	Algebra		3	Ratio		11	Algebra		2	Angles		3

Mar-21											
College 1 (Total) 166		College 2 (Total) 75		College 3 (Total) 59		College 4 (Total) 55		College 5 (Total) 55		College 6 (Total) 51	
Algebra	27	Algebra	20	Algebra	21	Ratio	15	Fractions	13	Fractions	14
Ratio	20	Ratio	11	Ratio	14	Angles	9	Money	4	Algebra	7
Angles	18	Fractions	6	Fractions	9	Fractions	8	Division	4	Ratio	6
Trigonometry	16	Probability	3	Pythagoras	6	Percentages	7	Percentages	4	Percentages	4
Fractions	13	Trigonometry	3	Percentages	5	Algebra	5	Ratio	4	Angles	3

The data implies that though there is some variation, the top five topics remain relatively constant throughout the academic year. This is not surprising in the sense that the timeframe is relatively short between both surveys (six months) and that such topics could potentially be areas of development that students have cited for many years.

What is key is that though data shows student confidence in maths has increased between the two surveys, those top five topics identified in October 2020 as requiring further support feature significantly in the second survey of March 2021.

Though the design of the survey encouraged students to identify topics, the next phase will be to classify what aspects of the topics students find particularly difficult as some the subjects that feature are broad. Equally, further investigation would be required to identify if the student responses were emotional or considered answers

With reference to the indication that some students lost confidence in their maths skills between October 2020 and March 2021, there were several comments about feeling the need to review all aspects of maths and that they were not able to select specific elements for the survey. Such responses reinforce that learning maths can be a challenge for learners, regardless of the learning environment.

Conclusions and Recommendations

Conclusions

1. The successful implementation of interactive maths software can empower students to develop confidence in their understanding of maths. However, successful implantation is complex and requires sufficient time and resource as well as student adaptation and buy-in.
2. Access to a consistent platform of learning such as interactive software can have an impact on student confidence in using computers to learn maths. The disruption of the Covid-19 pandemic in academic year 2020-21 resulted in changes of delivery that included greater use of consistently available interactive software.
3. Using interactive software to develop maths skills can polarise student opinion both positively and negatively. It can be used to supplement additional learning in a blended or flipped learning model to compliment lessons led by a tutor.
4. Alternative methods of delivery required to support all needs of students in a classroom. Those students who felt unable to engage with the software (to the point it lowered their confidence in learning maths) require guidance through other means. Interactive software can compliment, not replace tutor delivered lessons.
5. Maths topics that students find difficult feature throughout an academic year even after specific lessons have been taught. Regular reviewing of such topics throughout a scheme of work could improve student confidence in their ability to understand and engage with such subjects.

Recommendations

1. If launching or incorporating interactive maths software into maths delivery a planned structure of training and adaptation is required for both teachers and students. This requires time and resource to fund the development, including making hardware accessible to those students who require support.
2. Regardless of the software used, a consistent platform of learning can improve student engagement and interaction if implemented effectively. The planning phase is key to ensure all parties are committed to and understand the impact of launching such a resource, including allowing teachers to collaborate and explore software features in order to buy-in into the process. After all, it will be the teachers who will be encouraging students to engage with the software as part of a supplementary tool to their maths delivery.
3. Due to the polarising nature of interactive maths software it is key to allow users to feedback about the process and to review success at regular intervals. A programme cannot be launched and signed off, it is a process that evolves over time, requiring input from all parties from senior management to the student.

4. Be aware that positive results will not be instant. Implementing maths software requires months of cycles of research as both tutors and students learn and understand software. For the colleges involved in this process, use of the software is in at least the second year of delivery and represents a long-term commitment to understanding the more advanced elements of the software.
5. Ensure student feedback is captured effectively. They are the end-user and can offer key insights that can support the successful integration of such a resource.
6. Review and revisit topics that have already been taught in an academic year. Students require time to understand transferable knowledge in order to apply it to different situations. The fact that topics students would like support in changes little between both surveys indicates those subjects require regular recaps in order to support the development of student confidence.

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Appendices

1. Sample student survey.



**CENTRES FOR
EXCELLENCE IN MATHS**



**Stamford
College**
Part of the Inspire Education Group

Student questionnaire form 20-21

Please complete the following questions as part of the Centre for Excellence in Maths programme				
College name				
Date of questionnaire				
Please answer the questions below:				
1. What course are you studying at Stamford College?				
2. On a scale of 1-5 how would you judge your confidence in maths at this point in time? (1 = not confident at all, 5 = Extremely confident)				
1	2	3	4	5
3. On a scale of 1-5 how confident are use in using computers to learn maths at this point in time? (1 = not confident at all, 5 = Extremely confident)				
1	2	3	4	5
4. Name 2 topics in maths that you might like specific support in:				
A				
B				
5. On a scale of 1-5 how effective do you judge the software in helping you progress and learn? (1 = not helping me progress at all, 5 = helping me to progress a lot)				
1	2	3	4	5
6. Explain your answer from question 5 – why did you choose the number you did on the scale?				
7. In a sentence or less, what is your understanding of blended learning?				
Thank you for taking the time to complete this questionnaire – please return the form to your teacher				

2. Sample reflection form



**CENTRES FOR
EXCELLENCE IN MATHS**



**Stamford
College**

Part of the Inspire Education Group

Monthly observation and reflection form 20-21

September / October / November / December / January / February / March

General Information	
College name	
Tutor name	
Brief summary of progress	
Identify the key progress points of the project since the last report	
Identify any areas for further development and potential improvements	
One sentence summary of reflection of progress including the course / topic	
Reflection	
Some points to consider... • How are students responding to the project/ILT/software? • Preparation and up-skilling on ILT/software - has it been for you? • What problems have you encountered (if any)? • What changes/developments have you made/introduced since last month? • Has feedback from students impacted on the project? • What have you had to respond to as an individual or as a team as part of the new national lockdown this month? How does this link to our action research question: <i>Introducing blended teaching and learning opportunities through the use of interactive maths software</i>	