EDUCATION & TRAINING FOUNDATION

TEACHING WITH VIRTUAL REALITY

In 2018, as part of the Education & Training Foundations' Outstanding Teaching Learning & Assessment grant programme, a partnership of Sussex training providers explored the effective use of virtual reality technologies in the classroom. The project published the website www.teachingwithvirtualreality.com as a resource for practitioners.

JAMES MICHAEL MALTBY (EDITOR) – 17/07/2018

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OVERVIEW

Project Summary

Entry-level immersive technology has reached a price and complexity point where it is now accessible to the average classroom, but how can teachers effectively integrate these technologies into their lessons? In 2018, Plumpton College received research funding from the Education & Training Foundation to explore the use of virtual reality in the classroom. Plumpton lead a partnership of further education colleges, including Sussex Downs and Greater Brighton Metropolitan College, to explore the effective use of 360°, augmented and virtual environments in the classroom. After trialling various learning resources, the project published the website www.teachingwithvirtualreality.com to showcase example content and the colleges' evaluations as a guide for other practitioners.

Project Objectives

The three main aims of the project were to:

- Evaluate different types of immersive technology and content in the classroom;
- evaluate the impact of the technology on different types of learning activities;
- and publish example content and a framework of best practices for other colleges.

The main targets were to:

- Engage 10 new direct participants (teachers);
- engage 200 new direct beneficiaries (students);
- engage 100 new indirect participants (teachers);
- engage 1000 new indirect beneficiaries (students);
- broadcast through 2 external organisations;
- and produce 9 example immersive resources.

Initial Research

In the first phase of the project, the partnership researched the current state of virtual reality, trialled different types of technology and considered the potential impact on teaching and learning.

Current State of Virtual Reality

Source: www.teachingwithvirtualreality.com

The most immersive category of consumer virtual reality technology is often described as 'Full Room VR'. These setups require a powerful desktop computer along with a dedicated headset. They allow the user to move around the environment and the controllers enable sophisticated interaction. The average setup costs approximately £2000. Most content is based on computer generated environments and is expensive to produce. Although some colleges have been experimenting with making a small number of Full Room VR setups available to students, the partnership decided early on that this technology was not yet accessible to the average classroom and therefore out of the scope of this project. However, it is hoped that the teaching approaches and evaluations discussed will be equally applicable to this type of technology.

At the other end of the cost spectrum, in 2014 Google introduce their Cardboard standard in order to drive the adoption of entry-level virtual reality. Special apps available on most modern smart phone can be used with a head mount to create basic immersive experiences. These head-mounts cost on average £10 but the price of a smart phone must be taken into account if the user is not able to provide their own device. The original Google Cardboard was released as an origami kit to keep costs low but other manufacturers have released compatible head-mounts that do not require construction.

One of the limitations of head mounts is the small number of apps available and the limitation of the phone's camera to capture truly immersive photos which can be experienced within the headsets. Manufacturers have now released entry-level 360º cameras which can capture a photo or video in every direction from a particular position which can viewed on compatible VR devices. Entry-level cameras cost approximately £200.

Finally, in 2018 with the release of the Oculus Go, a new category of device has matured known as Mobile VR. These headsets combine the computing power of a mobile device with a purpose-built

head-mount that can create stand-alone virtual reality experiences. Unlike Full Room VR, users can not move around the environment but can still interact using special controllers. These devices are relatively in-expensive at approximately £200 per unit, which is comparable to buying a dedicated smart phone and head-mount.

Types of Immersive Resources

Source: www.teachingwithvirtualreality.com

After researching the current state of virtual reality technology, four categories of immersive resources were identified for evaluation during the creation of learning resources.

As discussed above, 360º photography describes technology that can capture static images at a specific location where the viewer can change the angle of observation as if they are physically at that position. It is potentially the most accessible to the average teacher. Free mobile phone apps like Google Cardboard Camera can create basic 360º scenes using the in-built camera. This could be used by teachers or students to create immersive learning resources or to capture evidence of learning.

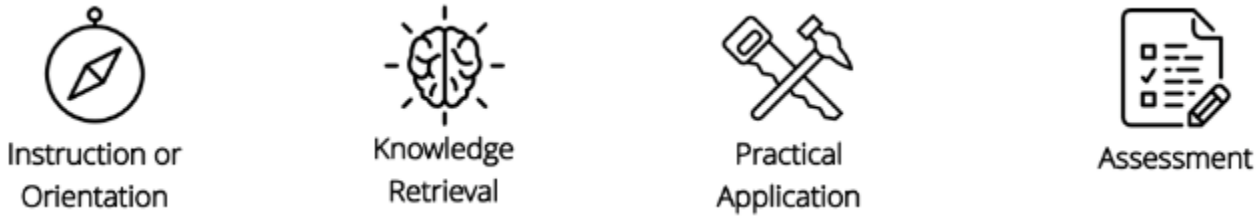
Furthermore, learning resources can be based on 360º video. The benefit of video is the potential for greater immersion and educational narrative. Dedicated 360º video cameras are in-expensive and accessible to the average teacher. However, initial tests found the complexity lies in finding the best way to publish resources to students. Also, like with normal video production, professional results require specialist personnel and extensive post-production.

From initial trials, it was discovered that an important benefit of the above types of immersive resources is they can be re-used on various devices with different levels of immersion. A 360º photo or video can be used without modification on a mobile phone, a tablet, laptop, desktop, projector as well as virtual reality headsets. The project found this flexibility important in a classroom setting.

Augmented environments combine immersive technologies with an activity at physical location. A basic example is QR codes in the real-world which can be scanned to launch complimentary immersive content on a device. Tools also exist to combine a series of 360º photos with interactive elements to create mixed reality generated environments like virtual tours.

Computer generated environments was identified as the least accessible due to the cost of equipment and the production of bespoke learning resources. However, they can also be the most immersive as they include interactivity unlike static photos and videos. The partners identified a number of free VR apps that were compatible with both Head Mount and Mobile VR setups.

Impact on Teaching & Learning



Source: www.teachingwithvirtualreality.com

Before commencing teaching trials, it was important to identify areas where the partners believed immersive technologies could have an impact within the classroom. The project identified four areas for evaluation.

'Instruction or Orientation' describe activities where students experience a learning environment or skill for the first time. Virtual reality could be a way of introducing students to a new learning area before they are physically able to in the real world.

'Knowledge Retrieval' describes tasks designed to test students' recall of previous learning. After a student has been introduced to new knowledge or skill, experiencing similar situations again through immersive technology may help to deepen and accelerate long-term learning.

In a 'Practical Application' exercise a student demonstrates skills or knowledge they have developed during a teaching programme. This goes beyond 'Knowledge Retrieval' as students will be actively applying skills they have learnt in a virtual environment.

Finally, in an 'Assessment' activity a student would be required to prove competence in a learning area. An examination could take place through a virtual reality environment, or a captured scene demonstrating a student's mastery of a learning criteria could be used as evidence within a portfolio.

Project Method

Each of the main college partners ran at least 3 trials using a mixture of the above technologies and target teaching objectives. The project output from each trial was an example resource and a case study containing evaluations from both the teacher and students involved in the lessons. These trials are discussed in more detail in the next section entitled 'Teaching Trials'. It was forecasted that the project would impact 10 direct participant teachers and 200 direct beneficiary students across the three main colleges. At the time of this report 15 teachers and 227 students have been directly involved.

In July 2018, the project published 10 trial learning resources and evaluations on the website www.teachingwithvirtualreality.com. The website is designed to be a guide for other practitioners who wish to start using virtual reality technology in their teaching. The content of this website was also used during the project to train staff indirectly involved with the project and with non-active partners. It was forecasted that there would be 100 indirect participant teachers and 1000 indirect beneficiary students. These learner estimates were based on a multiplier of 10 per indirect teacher. At the time of this report the project has indirectly impacted 122 teachers and an estimated 1220 students. It was broadcast to 79 practitioners and over 1500 students.

Who was involved

The lead organisation for this project was Plumpton College, a specialist land-based further and higher education provider based in the South Downs near Lewes. The college has over 1500 further education students. The project was led by James Michael Maltby, Learning Technology Manager within Teaching & Learning. Case studies were led by Michael Danks.

The second main partner was Greater Brighton Metropolitan College (GBMC) which is a recent merger between Brighton Metropolitan and Northbrook College in Worthing. The college is a general further and undergraduate education provider with over 3500 16-18 year old students. The case studies at GBMC were led by Marion Harrison, Rachael Thomas and Jonathon Vernon.

The third main partner was East Sussex College Group which is a recent merger between Sussex Downs in Eastbourne/Lewes and Sussex Coast College in Hastings. The college is a general further education provider with over 5000 full-time students. The case studies at ESCG were led by Kevin Jones and Sam Shuttleworth.

Finally, the e-learning teams at the University of Brighton and Sussex were invaluable in providing technical support to the partnership and helping to evaluate the higher education potential of this project. Particular thanks to Daniel Axon at Sussex University, Katie Piatt and Nick Feather at Brighton University.

TEACHING TRIALS

Plumpton College

Assessing welfare for Animal Care

Source: www.teachingwithvirtualreality.com

As part of their Level 3 Animal Management course, Plumpton College students were required to assess the husbandry regime of a local pet-store. However, the lecturer for the programme was unable to take a large class of students offsite and could only run a classroom-based lesson. Instead, the teacher took a Theta S 360º video camera to the pet store and recorded immersive content at three locations around the shop. Using smart phones and head-mount VR goggles, these videos were then made available to students in a theory lesson where they were writing an essay for their course. One table in the lesson was pre-prepared with three headsets for students to immerse themselves in the environment and consider critically whether the store was meeting the needs of their animals. A video tour was also recorded using an iPad for students were too anxious to use the headsets.

It was found that the quality of the essays that were produced was higher compared to previous cohorts and the overall pass-percentage increased. The students would not have been to access the environment without the VR headsets and the activity provided an engaging way of applying the practical skill of evaluating husbandry regimes within theory lessons. However, the teacher found the classroom time-consuming to prepare as the content had to be pre-loaded onto staff mobile phones before the lessons. There was not enough time to setup the content on student mobile phones. A consequence of this trial was that Plumpton decided to concentrate on using Oculus Go for future lessons as it is easier to preload content in advance ready for a class.

Attaching a trailer for Agriculture

Source: www.teachingwithvirtualreality.com

When approached with the idea of creating virtual reality resources for tractor driving skills, the instructors identified reversing and attaching a trailer as the hardest skill that novice students found to learn. It was important for students to remember the correct order of operations which required understanding of both the controls and attachment mechanism. This learning tasks seemed a perfect fit for a 360º video capture. The resource could be used both as introductory activity and as a regular exercise when students were practising their skills.

The learning technology team wanted to experiment with different ways of creating a stand-alone learning resource. The 360º video was augmented with text panels explaining each learning step in sequence. Picture-in-picture overlays were also used to show multiple angles. A second video was created which demonstrated bad practice. The team added warning markers when mistakes occurred to prompt students. These resources required extensive post-production and would not be recommended for every virtual reality learning video. However, because the material will be re-used in future years, it was important to create a polished resource.

The instructors used the resources with both tablets and with virtual reality headsets. During theory lessons they encouraged students to watch the videos multiple times to reflect on the correct procedure. Students who had not yet attempted the skills found the resource particularly useful. It helped to alleviate anxiety and improved their engagement with the real task.

The instructors were initially unsure how to introduce the resource into their lessons because they felt they did not have enough devices for every student. They were encouraged to use headsets as a station activity, but were still keen to be able to use the resources on a projector with the whole class. For future resources, the team learnt it is important to publish videos online so they can be accessed through laptops and desktop computers.

Identifying habitats for Countryside

Source: www.teachingwithvirtualreality.com

The countryside division took part in two separate trials for this project.

In the first trial, the lecturer wished to capture scenes of the Level 2's trip to Snowdonia to evaluate remote habitats. There were three teaching aims. Firstly, she wanted to use 360º learning resources with the group when they returned to help them re-experience the trip and retain knowledge. Secondly, some students were unable to go due to anxiety and she planned to use the photos as an activity for them when she returned to college. Finally, she plans to re-use the resources with next year's cohort to orientate the students before they leave. She used a handheld 360º camera on the trip and the resources.

In the featured trial, the countryside team wish to build a bank of different habitats that could be used in lessons during identification exercises. It was hoped that resources would engage students during theory classes and deepen understanding. Over the Spring, a learning technologist accompanied the class on countryside visits. They captured high-quality 360º photographs and videos using the GoPro Fusion VR camera. These resources were loaded onto Oculus Go headsets and published through Vimeo. The team used the resources during classroom theory lessons, particularly targeting students who were not able to attend specific site visits. The teachers found the resources invaluable during the end of the programme when they needed to help students complete their portfolios and were unable to re-organise visits. Some students were nervous at first with using the VR headsets but were still able to access the same materials through tablets, desktops and the classroom projector. The team plan to build on the resources in the coming year to create a full suite of learning resources.

Exploring space equipment for Science

Source: Oculus Go store. Developer: House of Fables.

Plumpton College wanted to run a trial that included computer generated environments to compare against 360º photography and video. The entry-level science teacher, planned to teach a series of lessons on how technology is used in space and enquired whether there was any pre-created virtual reality learning resources. The team found the official International Space Station Tour for Oculus Go. The VR app consists of an interactive replica of the ISS interspersed with learning videos and quizzes. In the classroom, Oculus Go headsets were used as a station within a carousel of activities. The learning objective for the activity was to explore the VR world and find examples of specialist equipment. Students then completed a written exercise on another station.

The students found the mobile VR headset and the app engaging and the majority of the 40 learners spent on average ten minutes within the virtual environment. In hindsight, the teacher reflected that they would have changed the order of the stations so that students were prepared enough to meet the specific learning objective. Students who started with the VR activity were not yet ready to identify appropriate technology compared to students who used the headset towards the end of the session. There was also no formative assessment at the VR station, so it was difficult to ascertain how much learning took place beyond engagement in the subject.

Greater Brighton Metropolitan College

Kitchen induction for Hospitability

Source: www.teachingwithvirtualreality.com

The hospitality division at GBMC saw a potential use for a virtual reality resource during their kitchen induction lessons. For each equipment station within the kitchen students, are required to complete a health and safety task and evidence that they have understand proper procedure. In previous years it has been difficult for the teaching team to engage students with these activities, but they are an essential part of the course. The learning technology team at GBMC saw the potential to augment this activity with videos and interactive elements in a virtual tour. The virtual activity could be completed either before, during or after the session.

For the project, the team got current students to record short video clips demonstrating each area of the kitchen and proper procedures. They also recorded close ups and extreme shots relating to specific tools. Finally, 360º photos were taken of various points in the room. All of this content is currently being put into a virtual tour using ThingLink along with consent forms and quizzes that the students needed to complete at each station.

The biggest challenge was getting the virtual tours to work effectively on virtual reality headsets. Head-mount VR has limited interactivity. Since the virtual tour was designed for browsers, the resources worked better as an immersive website accessed from the college's digital classroom.

Identifying airplane parts for Aeronautical Engineering

Source: www.teachingwithvirtualreality.com

The aeronautics workshop at GBMC contains a large selection of specialist equipment that students need to become familiar with in a short period of time. The team saw the potential to take immersive 360º videos of tools and part in operation as both a student induction activity and as a regular refresher throughout their programme.

Each tool or part was capture by the learning technology team and current students. Wide-angle photos of the workshops, garages and other practical areas were also captured. All of this content is currently being put into a virtual tour using ThingLink.

Like with previous trials, the biggest challenge was getting the virtual tours to work effectively on virtual reality headsets. Head-mount VR has limited interactivity. Since the virtual tour was designed for browsers, the resources worked better as an immersive website accessed from the colleges digital classroom.

Showcasing students work for Prop Making

Source: www.teachingwithvirtualreality.com

For their final trial, GBMC wanted to see how virtual reality could be used to showcase students work for their portfolio of evidence. Students on the Prop Making course created a wide variety of products for their end of year show. The teaching team could see the potential of using 360º photography to capture as much detail as possible from the work and to present all of the items in an engaging way to remote viewers.

Students used 360º cameras to take pictures of their work. They also created an individual blog describing their working method. The learning technology team at GBMC then took these materials and are currently building a virtual tour where the user could explore all of the items and link through to the students' blogs and other resources.

Like with their other trials, the biggest challenge was getting the virtual tours to work effectively on virtual reality headsets. The resources worked better as an immersive website accessed from the colleges digital classroom.

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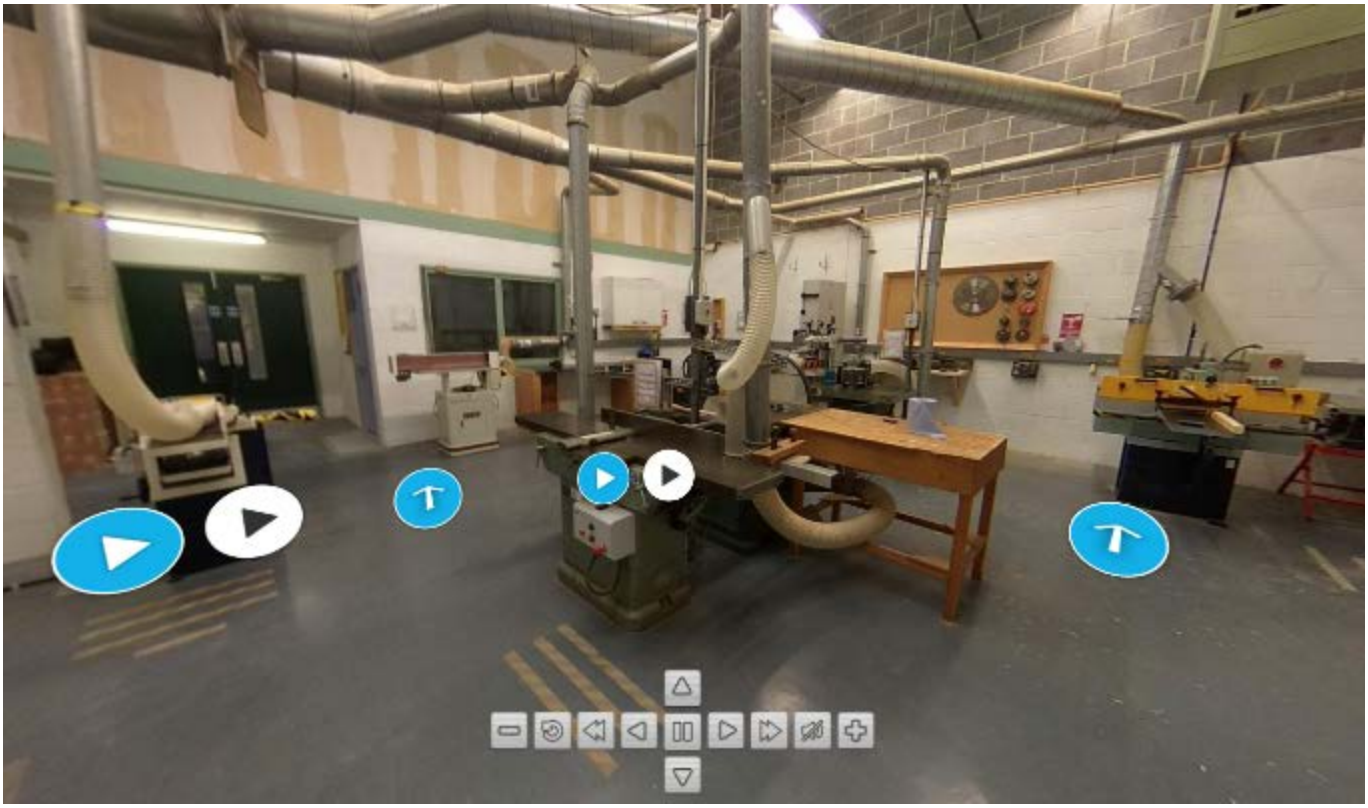
East Sussex College Group

Workshop induction for Carpentry



Source: www.teachingwithvirtualreality.com

For this case study, the ESCG wanted to create a resource that allowed users to explore the carpentry machine workshop. Collaborating with the lead carpentry lecturer, the innovation team chose a selection of machines that included a mix of those students would use as part of their course of study, and some that were only part of a level 3 course of study. For capture they used a Theta V VR camera to capture the photographic content, and to record 360 demonstrations of the machines in use.

The team discovered while producing the content that it was possible to capture a large enough field of view of the workshop that only two 360 photos were needed. These were linked using the VR tour software 3D Vista, and the video content was then embedded into the resource. This was then uploaded to our servers to be shared. We discovered however that standard web servers do not support the correct video codec for 360 videos, so these were not displaying correctly. Instead, the videos were each uploaded to YouTube and shared.

They tested out two formats when showing the resource to our students. First, they displayed the full resource on the large screen TV in carpentry's main work space. Secondly, they provided several VR headsets to try out the virtual look around of the machine shop minus videos, as the teacher was unable to get VR mode on YouTube to work on the student's mobile phones.

"I like seeing (the machine shop) clean!" was one of the first responses. On speaking to the lecturer, after the demonstration the team agreed that showing a "best practice" example of how to leave workspaces was a welcome unexpected bonus of the resource.

“It’d be cool to still have this after I leave to remind me how to do things.” This student was very happy to hear that the link to the resource would still work for them after they left the college, and also liked that it showed them a trusted first look at how to use the machines they hadn’t been able to use properly.

“Getting to see (the machine shop) more is good, get used to the room.” This student was referring to the fact students don’t spend a huge amount of their course in this workspace, and went on to say they would feel “safer” being able to familiarise themselves with the space before using it.

“(This is a) more fun way to revise stuff than reading about it.” This was a sentiment a few of the students shared. They liked being able to “explore” instead of just passively looking at documentation on its own.

Some students were nervous about using the headsets in front of their peers. There was an anxiety of “looking silly”, but gradually the teacher encouraged most of the group to try it.

The lecturer was happy with the potential of the resource, but wants now to start to add more substantive content like health and safety manuals, and hopes to set it as a flipped learning homework task accompaniment in the future.

Identifying equipment in the garage for Motor-vehicle

Source: www.teachingwithvirtualreality.com

The motor-vehicle team at ESCG wished to record 360º video of students undertaking various practical tasks in the garage. Students would then watch and reflect on their performance in the following theory lesson in order to encourage deeper analysis and knowledge retention.

The college used the Theta V VR camera. This was chosen for its affordable price and quality of output. The quality of the eventual footage we captured was of a higher quality, but the team did come across a selection of issues using the camera. Firstly, recording footage longer than 5 minutes starts to become tricky to remove from the camera via USB connection. This meant video had to be transfer over a wireless connection to a mobile handset. The issue was caused by the Theta not charging effectively when transferring, and its battery life is not long enough to transfer large files. These factors caused significant delay in the completion of this case study.

The team eventually managed to work around this constraint and uploaded the above VR video to YouTube unlisted. When the lecturers were happy with the quality, they arranged the follow up reflection session with the motor vehicle students.

“This is so weird.” This student had not fully realised they were on camera the whole time, so was shocked to see themselves working at the bench. They admitted that not having a camera pointing right at them felt more natural. “It’s weird watching (themselves) working like this.” was a similar sentiment expressed by others in the group.

“It’d be cool to show people what I can do with this.” This student liked the idea that they could take

away a video like this to show them working unedited on a project. The same student suggested: “It’d be cool to see like, a demo of the same thing from two different angles?”

The curriculum team happy with the finished content but plan to produce a staff demo along with student demonstration as a comparison. It was noted that students found reflecting on their techniques easier when they were able to watch them back in this format.

Virtual tours for Travel & Tourism

Source: www.teachingwithvirtualreality.com

ESCG approached their Travel and Tourism department to use Google Expeditions as a tool to take Travel and Tourism students on a virtual guided tour of somewhere they might have been learning about as part of their course.

Whilst preparing for the trial, they also identified some promising content from YouTube shot in 360 that could accompany the planned Expedition. They focused efforts on the Great Barrier Reef for the most “wow” factor and found a suitable Expedition and YouTube video of the reef to use with students.

In the first session, students had a variety of smartphone sizes. The college decided to purchase two different types of VR headset. The first was a small zip-up able to accommodate phones up to 6” in size. The second was able to take phones up to 8” in size with a strap holding the device in place. They decided not to use interactive remotes with the headsets as their setup was forecast to take up too much lesson time.

“What am I meant to be doing?” This was a quote from a student after looking around inside Google Expeditions for about 10 seconds. This was a common confusion among the students who, while they expressed an interest in the content, lamented in one case “I like that I can see all this (in Expeditions), but it’s sad it’s just images rather than video.”

When the team decided to show them instead one by one the video content, the response was almost immediate: “Wow!” The student who said this is the same we interviewed afterwards

Following this session, the lecturer invited us to launch the YouTube video with her new incoming students on their taster day. For this session the college did not use Google Expeditions, and

instead gave students the choice of two videos to watch, and then asked them to reflect in pairs the impression of the location they got from the footage.

“It’s really different to what I’ve done before.” This student explained that at their secondary school nothing like this had been done with them, and it was “exciting” to do something more “out there”.

“I enjoyed it, but it was complicated to get working.” For a few of the students getting the resource to display was tricky even after a walkthrough at the front of the class. We also found that several students either didn’t have or weren’t aware they had the YouTube app downloaded, which was an assumption the team had erroneously made going into the session.

Summary of Teaching Trials

PRODUCT NAME	DATE COMPLETED	NUMBER OF USES	APPORVAL SCORE?	ACTIONS TO IMPROVE
For practitioners				
www.teachingwithvirtualreality.com	17 July 2018	-	-	Further broadcast to other providers
For Learners				
Plumpton College				
Assessing animal welfare for Animal Management	31 Mar 2018	40 students	See above	See above
Identifying Habitats for Countryside Management	31 Mar 2018	20 students	See above	See above
Attaching a trailer for Agriculture	31 May 2018	12 students	See above	See above
Exploring equipment used in Space for Entry-level Science	31 May 2018	40 students	See above	See above
GBMC				
Kitchen induction for Hospitability	31 May 2018	36 students	See above	See above
Identifying airplane parts for Aeronautical Engineering	31 May 2018	12 students	See above	See above
Showcasing students work for Prop Making	31 May 2018	12 students	See above	See above
ESCG				
Workshop induction for Carpentry	30 Jun 2018	16 students	See above	See above
Identifying equipment in the garage for Motor-vehicle	30 Jun 2018	12 students	See above	See above
Virtual tours for Travel & Tourism	30 Jun 2018	27 students	See above	See above

BENEFITS

Benefits achieved to date

The following table summarises the direct benefits achieved during the project:

PARTNER	DIRECT PARTICIPANTS	DIRECT BENEFICIARIES
Plumpton College		
Assessing animal welfare for Animal Management	1	40
Identifying Habitats for Countryside Management	2	20
Attaching a trailer for Agriculture	1	12
Exploring equipment used in Space for Entry-level Science	1	40
GBMC		
Kitchen induction for Hospitability	2	36
Identifying airplane parts for Aeronautical Engineering	1	12
Showcasing students work for Prop Making	1	12
ESCG		
Workshop induction for Carpentry	2	16
Identifying equipment in the garage for Motor-vehicle	2	12
Virtual tours for Travel & Tourism	2	27
Totals	**15**	**227**

Residual benefits expected

All of the resources produced during the project will be reused with the new cohorts of students during the 2018/19 academic year. Each college also intends to directly involve other curriculum teams in the creation of new resources. For example, during the project, Plumpton College indirectly involved teaching staff from animal management, agriculture, countryside, equine, and sport. The college provided training to teachers from Bedford and Meyerscough College. Greater Brighton Metropolitan College indirectly involved teaching staff from carpentry, hair & beauty, motor-vehicle and theatre studies. Plumpton College and GBMC also ran a teacher workshop as part of the Association of South East Colleges Teaching & Learning conference.

Collaboration in Review

This project was a true collaboration between the three main project partners as well as the broadcast organisations who helped disseminate the research. The partnership believes the success of the collaboration was due to clearly dividing the teaching trials between each of the colleges and regularly sharing trial resources, evaluations and good practice. Please see the section above entitled 'Teaching Trials' for comments from individual partners.

Project Reach

The following tables summarise the project's reach at the time of writing this report:

PARTNER	DIRECT PARTICIPANTS	DIRECT BENEFICIARIES	INDIRECT PARTICIPANTS	INDIRECT X10 BENEFICIARIES
Plumpton College	5	112	62	620
GBMC	4	80	19	190
ESCG	6	55	5	50
Other	-	-	36	360
Totals	**15**	**227**	**122**	**1220**

BROADCAST	DATE	NUMBERS
Sussex Council of Training Providers	23 Mar 2018	10
FE Sussex	22 May 2018	10
Landex	23 May 2018	20 attendees + 39 principals emailed
Sutton STEM Event	13 Jul 2017	Over 1500 students
JISC Case Study for FELTAG 2018	Summer 2018	tbc
Swansea University VR Conference	12 Sep 2018	tbc
	Total:	**79 teachers & 1500 students**

PROJECT SUSTAINABILITY

As outlined above in ‘Benefits > Residual benefits expected’ each partner college expects to reuse all of the resources created in the next academic year and develop new resources as a result of the indirect participation of other curriculum teams who have been inspired by the project.

Plumpton College also plans to develop a resource sharing partnership with other land-based colleges. It is currently working with Myerscough College for their own Outstanding Teaching Learning & Assessment project on Virtual Reality as well as the Landex organisation and the National Land-based College.

The project has been invited to present its final report at Swansea University’s 2018 VR Conference on the theme of ‘Virtual and Augmented Reality to Enhance Learning and Teaching in Higher Education’. There are plans to broadcast the project at other national conferences in the 2018/19 academic year.

CONCLUSION

Entry-level immersive technology has indeed reached a price and complexity point where it is now accessible to the average classroom. The trials also suggest that the effective use of the correct technology for the right teaching aim can lead to outstanding learning outcomes. However, the creation and publication of virtual reality resources still remains difficult for the average teacher.

The biggest challenge faced during the trials was how to scaffold learning activities without the input from a specialist learning technologist. The most sophisticated resources were prepared in advanced and introduced in time-tabled lessons. However, close input from curriculum teams was crucial in creating resources that supported learning objectives. The greatest impact was achieved when learning resources were available in different mediums, for example through virtual reality, tablet and desktop computers simultaneously. This helped make materials accessible to students across multiple devices and outside the classroom. Virtual reality was particularly difficult to support in all cases. The most effective virtual reality workflow proved to be creating 360^0 video content and publishing through Mobile VR headsets like the Oculus Go.

The benefit for teaching & learning was most prominent for ‘Induction & Orientation’ and ‘Knowledge Retrieval’ tasks. Activities involving ‘Practical Application’ and ‘Assessment’ of skills required a greater degree of interactivity than was possible to implement during the teaching trials. However, trials with giving students the tools to capture 360^o themselves as part of the assessment process proved successful. As educational tools and expertise improve it is hoped it will become easier to create and publish interactive immersive resources.