The use of technology in the assessment of vocational qualifications – a review of practice

CYMWYSTERAU CYMRU QUALIFICATIONS WALES

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Contents

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Background

Qualifications Wales' 2018 review of qualifications in Construction and the Built Environment[1] raised concerns about the validity, manageability and learner engagement with the assessment of vocational qualifications. It was felt that technology may have the potential to address these concerns. Qualifications Wales commissioned Pembrokeshire College to identify, investigate and describe 5-7 examples/cases of innovative or good use of technology in vocational qualifications with a view to disseminating good practice and encouraging innovation.

This document is a collection of examples highlighting the use of technology in the assessment of vocational qualifications. It is the result of a large-scale exercise that canvassed the whole of the Welsh and UK vocational education sectors to identify interesting examples. The purpose of this document is to inform professionals in the sector of the potential that technology can have in improving assessment practices and inspire innovation.

Research method

An online form created to collect detail of examples was made available via Pembrokeshire College's website. The form was made active at the beginning of January 2019 and closed at the end of January 2019. A review panel of representatives from the sector was established to promote the project and to select examples to be included in the final set.

The review panel were tasked with broadcasting the request for examples within their own organisations and the members of the consortia they represent. The consortia included NTFW (147 Welsh work-based learning [WBL] providers), bWBL (consortium of 10 Welsh WBL providers) and the Blended Learning Consortium (representing 40% of UK FE providers).

All awarding bodies offering vocational qualifications were contacted to provide examples and to disseminate the request to their centres. An item was included in Welsh Government's Dysg newsletter with a link to the online form. JISC was also engaged and they indicated their willingness to help in identifying existing examples across their organisation from HE, FE and WBL contexts.

Each member of the review panel was asked to score the examples from 8 (highest) to 1 based on how innovative they were and how easily other providers could adopt or could learn from them. The scores from each panel member were aggregated and the top eight examples were selected. The selected examples were then investigated in more detail by interviewing staff in learning providers and learners. The names of people interviewed during this research are mentioned in this report with their permission.

Submitted examples

A total of 56 examples (see the appendix) from across FE and WBL in Wales and England were submitted. These examples were grouped in nine categories, as shown in the appendix. In some cases, examples satisfied the definition of more than one category. The 'Miscellaneous' category examples included the use of ebadges and the use of QR codes.

No responses were provided by Awarding Bodies, however UAL did emphasise its encouragement of centres to exploit the use of technology in the delivery and assessment of its qualifications.

Qualifications Wales was particularly interested in examples where technology is used in summative assessment. However only a few examples of summative assessment were found compared to the use of technology in formative assessment.

The selected examples can be placed into five broad categories as shown in this table. Several examples overlap categories but the categorisation provides a loose frame for presenting them.

Rich-media / resources for recording evidence and providing feedback	These are teaching materials that utilise rich media (animations, video, audio and interactivity). Some examples focussed on providing feedback on learners' work via video, audio or screen captured video interactions. Other examples focused on the recording of practical skills.
New forms of media	These include virtual reality, 360 videos, augmented reality or even a mix of these. These technologies are becoming increasingly viable to use in recent years as costs have fallen.
Cloud authoring of assignments/work by learners	Cloud-based applications enable learners to author or submit materials that are shared with other learners or tutors for concurrent working and for comment or marking, respectively. These examples included the use of online communication tools (e.g. chat) to work with and assess learners in real-time.
e-Portfolios	Platforms that collate learners' work associated with elements of their qualification. E-Portfolio platforms can be highly structured, where work is related to specific criteria, or more loosely arranged as a simple storage place for learners' work.
Other	This category includes use of learning management systems (LMS), virtual learning environments (VLE) and computer-based objective testing (e.g. quizzes, multiple-choice questions).

As the use of LMSs, VLEs and computer-based objective testing is now well embedded in practice, examples of these have been omitted from this document. Therefore, the rest of the document presents the examples under these broad categories:

- Rich media
- New forms of media
- Cloud authoring/working
- E-Portfolios

Use of rich media in assessment and feedback

Interactivity with rich media — information that is presented in any combination of text, audio, video, and animation — is commonplace in most aspects of the teaching and learning process. The examples of rich media use that were collected for this study can be broadly categorised as follows:

Use of rich media in teaching and learning	In these examples, rich media is used for explanatory purposes to cover elements of their curriculum.

Providing feedback by rich media	These examples take the use of rich media a step further by using it to give feedback, mainly in formative assessment.
Recording assessment evidence via rich media	In these examples, rich media is used to capture assessment evidence required for a qualification.

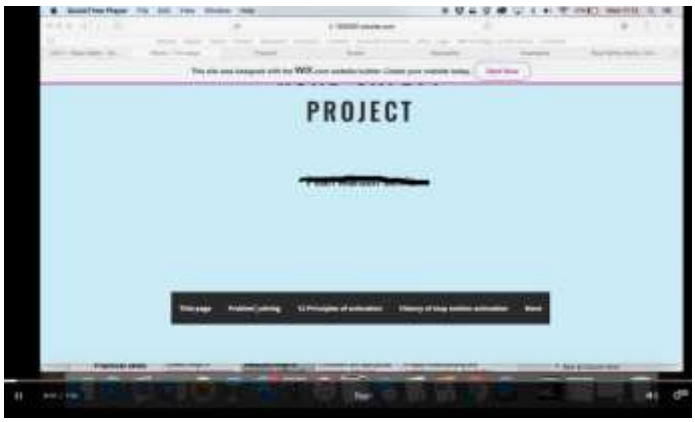
Screen recording for summative and formative assessment Pembrokeshire College

Pembrokeshire College runs Pearson's Creative Media Production Level 3 Extended Diploma accredited by UAL. Denys Bassett-Jones is the course tutor. The assessment of the course is through portfolios of work for each unit. The majority of these units are assessed and moderated internally and given either pass or fail. UAL allows centres offering their qualifications to provide learners with feedback once before a final summative piece is submitted. Historically, Denys would type up a feedback sheet and try to describe the location in the learners' work to which a particular comment was attributable (e.g. 'second image on the left on the third screen'). This was time-consuming and made it difficult for learners to see Denys' comments in context, and there was always a significant delay between submitting work and receiving feedback.

Denys decided that he could record his screen as he navigated a piece of learner's work and at the same time provide a narrated commentary.

Denys used the assignment for the 'Investigating Interactive Media Production and Technology' unit of the course that requires learners to 'produce an online media campaign highlighting the most common factors in road traffic collisions'. To complete this assessment, learners build a web site using readily available tools on the Web and then share the link with Denys.

When it comes to marking, Denys clicks on each link and then uses screen capture software to record his feedback as he scrolls through the learners' work, pausing to comment on each element. Denys stores each feedback recording onto OneDrive. Click on the image below to watch and example.



Prior to the feedback recording, Denys will have already made his grading decision and typed this into a feedback sheet for each learner (Click here to see an example completed assessment form). Denys completes the feedback sheet by pasting a link to the recording into it.

Some of the learners create physical artefacts (e.g. a book) rather than a website. In this case, Denys sets up a video camera pointed at the artefact and then proceeds to record himself as he reviews the artefact and provides a commentary on his assessment of each element and how it relates to the assessment criteria.

Learners are happy with the new approach and welcome receiving formative feedback more rapidly than they otherwise would. They also have a fuller understanding of the rationale behind the final mark that they have received.

Denys has now extended this approach to all assessments for all the modules for which he is responsible.

Advantages

- A recorded narration helps the teacher to direct feedback to a specific learner. The narrated feedback, especially with digitally presented work, ensures that it is linked to the relevant point in the learner's work. Hence it tackles a challenge with written feedback (formative or summative) to make it personalised; rather than write the same generic comments on each learner's work. Previously, Denys provided feedback by sitting alongside each learner and going through the work with him or her. This approach often meant learners missed the feedback or could not remember it afterwards. The recorded feedback means that learners can return to it as many times as they wish, without losing any of the fidelity.
- It is fair to note that young people spend a lot of their time learning from videos and watching films, so this approach suits them. A lot of written comments and technical language can be quite hard for them to decipher. This method gives the tutor the chance to provide quality feedback more effectively and without having to spend time writing long explanatory passages.
- Denys can narrate comments quicker than he can write them; and the comments are potentially more understandable than a written equivalent;
- Instead of learners having to read a written description of the applicable location for each comment, they can see for themselves where the comment is pertinent;
- Comments related to dynamic content (e.g. embedded video) are easier to make; and
- Learners can fast forward and rewind the feedback to review comments repeatedly. (Clearly, learners could read the same written comment repeatedly but dragging the 'play-head' of a video has perhaps more immediacy).

Technology

As Denys largely works with Apple iOS-based devices, he uses Apple's -applications to record his narrations and capture the screen as he navigates a piece of learner's work. However, there are many other options for screen capturing (including browser plugins) and many of them are free. A search online for 'screencasting' applications/software will return a range of existing possibilities.

Annotated video of practical skills

Karen Walker Jones is the work-based learning (WBL) team leader in the hair and beauty section, Grwp Llandrillo Menai College. Karen provides formative assessment to learners on their hair cutting skills using an application called CoachMyVideo. CoachMyVideo allows users to overlay an existing video with a commentary, slowing or pausing as required in order to discuss particular elements of the video. CoachMyVideo also allows users to 'draw' over a video using a number of different tools in order to highlight learners' practical skills, for example, the angle they hold their arms whilst carrying out a particular cutting technique. The image below shows the same learner and client in both videos. The learner is holding the hairdryer incorrectly in the video on the left. After watching the video playback and being asked to identify any areas in which she could improve she has then changed the angle of the hairdryer in the right-hand video. When blow-drying hair, the dryer nozzle needs to be facing down the hair shaft and the heat needs to be focused on the root area.

Screen shot of using CoachMyVideo to provide feedback to learners on their technique. The video on the left shows the learner blow-drying the client's hair improperly; the video on the right shows the learner using the correct technique following a review of the first video.

Karen video records learners with her iPad while they are cutting hair and then uses CoachMyVideo to carry out the analysis of the learners' practical skills, explaining where the learners have carried out a technique correctly and where they might improve. Karen often plays back the recording together with learners in order to discuss their technique, illustrating important points using the annotation tools in the app. CoachMyVideo also enables users to run two videos alongside each other so that a learner's technique can be compared, step by step, with that of an expert practitioner or other learners. Karen has mostly used CoachMyVideo for formative assessment, but she has also used it to record summative evidence, enabling learners to include the recordings in their portfolios.

Learners from other areas also value the feedback they get from CoachMyVideo:

'The application is brilliant and has helped me identify my weak areas, it can be as simple as changing which end of the fish I start with or the way I'm holding the knife.'

Technology

CoachMyVideo is only available on Apple's iOS-based devices, however, there are alternatives available on Android and Windows-based devices. These tools are most often associated with sports coaching but are just as applicable to the evaluation of any other practical skill.

Recording of evidence using digital voice recorders

The training officers at Clybiau Plant Cymru "Kids' Clubs" use digital voice recorders (DVR) to support the collection of evidence for the 'Playwork' qualification. The DVR enables the training officers to collect recordings without taking video recording devices into a childcare establishment where these would not be permitted. Clearly, in this environment, video recordings would not be permitted.

Using the DVRs to record the necessary professional discussions between learners and training officers captures the learning outcomes more accurately and is less disruptive than making written records during the discussions. The DVR approach makes the verification process straightforward as quality assurers can hear directly from the learners, allowing them to determine how independent their views are from any influence by the assessors.

Audio records are particularly helpful to learners who might have limited literacy skills and find producing lengthy written evidence challenging. Learners are expected to produce some evidence in written format, but the DVR enables the majority of this to be replaced with voice recordings. The use of DVRs makes it easier for learners to demonstrate their understanding and knowledge of playwork with greater ease. This, in turn, boosts their confidence and empowers them to produce more of their evidence in written form.

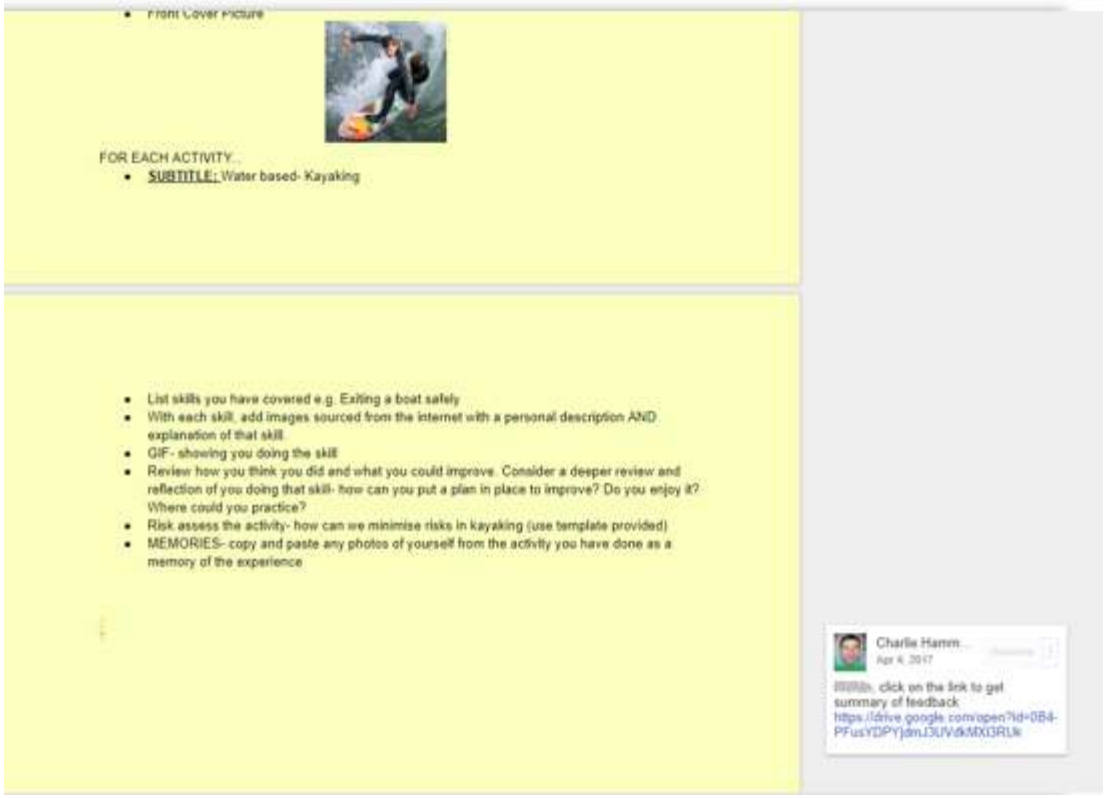
Dawn Bunn, the national training manager, observed that 'the one thing you have to manage is ensuring that the length of the audio clips is not too long, so they do not become unwieldy'.

Phoebe Wilson, a training officer, added:

'*I like using the DVR as it helps collect a range of evidence*.'

Rich media feedback

Charlie Hammond, a sports science lecturer at Coleg Sir Gar, uses screen capture technology to provide formative feedback on assignments to his learners. Learners submit work via the College's VLE — Google Classroom. Charlie opens up each learner's work on his screen and records himself navigating the document and narrating his formative feedback, a process called 'screencasting'. Once he has completed his feedback, he adds a comment to the document with a link to the video of the feedback, as shown here:



A section of a learner's work to which the lecturer has added a comment with a link to the video commentary on the quality of the learner's work.

The learners are encouraged to watch the feedback video with their work also open so that they can amend their work as they work through the feedback. Once learners have responded to all the feedback given, they are required to add a reply to the teacher's original comment, confirming that they have addressed all the feedback. Coleg Sir Gar uses the learners' comments as an audit trail.

Charlie estimates that video feedback provides significantly more useful content than the equivalent written feedback.

Learners' use of screencasting

Charlie also reverses the use of screencasting by getting learners to reflect on their own performance. For example, Charlie records learners undertaking a sports activity such as kayaking and then asks them to use ScreenCastify to reflect on their performance as shown in this example:

The learner (bottom right) is recording his own commentary on the kayaking clip.

As part of their course, learners are required to present to the rest of the class. For some learners, presenting to the rest of the class can be intimidating and challenging. In these cases, learners are allowed to use screencasting to record themselves providing a narration over the top of their presentation slides.

Technology

Charlie uses a free plugin to Google Chrome to record his feedback on each learner's work. This plugin gives users the option to record different windows or screens if more than one is being used. Learners save their work to the College's VLE — Google Classroom — which is then automatically shared with the lecturer, Charlie, so he can easily access the work and add his comments.

Conclusions

Providing feedback using rich media, whether formative or summative, is easier for the education professional than physical marking and more helpful to learners. However, some of the challenges for teachers who want to adopt similar approaches are as follows:

- The need to get used to the sound of their own voice and to not be concerned that the recordings are not 'broadcast' quality; and
- Becoming adept at using the necessary software and hardware.

New forms of media in assessment

A number of new forms of media have emerged over the last ten years and have become affordable for mainstream use in education. These include 3D photographs and videos, 360° photographs and videos, virtual reality (VR), augmented reality (AR), and mixed reality (MR).

3D photographs and videos

3D photographs and videos require the user to wear special glasses to get the illusion of depth. Many people have seen 3D films at the cinema where the production costs are very high. However, the technology to record and produce either 3D photographs or videos is now affordable for any education provider.

360° photography and video

Whilst watching a 360° photograph or video, the viewer can move their point of view through 360° and even zoom in and out. The cost of producing 360° photographs is low; they can even be recorded with smartphones. In particular contexts – for instance, inside a motor vehicle workshop or inside a historic house – 360° photographs offer the learner an extra dimension to conventional photographs. However, the question is to what extent is the learning experience enhanced in any meaningful way by the learner being able to change their point of view? 360° photographs, on their own, do not have any intrinsic quality that makes them more suitable to be used for assessment purposes, but they could be profitably utilised with instructions or questions, for example, 'identify the hazards in this photograph'.

360° videos are recorded with special cameras that simultaneously record in all directions from a fixed position. These can be of benefit in vocational subject areas where learners interact with each other in space and time, such as dance, acting and sport so that they can see themselves in relation to those around them afterwards.

Combined media

It is possible to combine both 3D and 360° formats in a single medium. The combined format requires users to wear 3D glasses.

Virtual reality

Most people are now familiar with the concept of VR and even if they have not experienced it firsthand, they will have seen examples of people wearing VR headsets and using motion controllers and will have seen clips of the associated virtual spaces. VR does not necessarily require headsets; simpler 2D versions can be displayed on computer screens and interacted with by using a mouse or touch screen. A good overview of VR can be found here:

https://www.explainthatstuff.com/virtualreality.html

VR is now being used in many areas of life including education. VR enables learners to enter environments that they would not otherwise be able to access, for example, where the situation is:

- Too hazardous such as a burning house;
- Too expensive or complex such as a visit to the House of Commons; and
- Impossible, such as being inside a molecule.

With different input devices such as joysticks, learners are able to manipulate objects in a virtual work environment and undertake typical work-related activities such as welding a pipe. Input devices include force balls, tracking balls, controller wands, data gloves, trackpads, on-device control buttons, motion trackers, bodysuits, treadmills, and motion platforms

A learner's virtual or simulated demonstration of a real-world skill in a VR environment could be the basis for a summative assessment. However, until it is widely accepted that virtual reality is as sufficiently authentic as the real world, it is understandable that the awarding bodies require learners to demonstrate the real-world skill when being assessed.

Augmented reality

Augmented Reality (AR) means overlaying views of either the real world, a recording of the real world (photographs or video), or VR with additional information (e.g. explanatory notes or videos), hyperlinks, or interactivity (e.g. quizzes). For example, when looking at a lathe with special glasses or through a tablet or phone, a video pops up to explain each component.

AR can enrich learners' experience and help them better understand the concepts in question. However, its value in the summative assessment of vocational qualifications is limited, in that AR is something that a learner only experiences; unless the AR environment can be made to output learner interactions for later summative assessment. Maybe, in the near future, when a learner interacts with an AR environment, the interaction (e.g. manipulating levels on a graph) could be recorded and used to form the basis of assessable material. It is also possible that the construction of an AR application by learners would itself become the assessable material rather than the traditional means such as a typed report.

Mixed reality

Mixed reality is the relatively recent idea of mixing real-world views with virtual-world views so that an observer wearing appropriate equipment will see a mixture of real and virtual world elements. A hypothetical example might be a learner walking around a real kitchen and seeing a virtual fire breaking out from a pan on a real cooker. It is probably too early to see examples of mixed reality used in education or in assessment.

This table summarises how these technologies may potentially be used in learning and assessment.

Technology	Learning	Assessment
3D	3D views of some contexts in which learners may find themselves, such as a factory floor, may help them to better understand the context with the extra dimension of depth.	3D photographs or videos are simply viewed in the same way as their 2D counterparts. The only interactions possible are to play, pause or rewind them, none of which are captured and stored. Therefore, their role in assessment has to be combined with other instructions and assessable evidence like a separate report. The disadvantage of 3D media is the need to have 3D glasses that do not suit everyone as some people become nauseous. However, the cost of producing 3D media is now very affordable.
360°	The benefit of seeing something from different points of view means that learners may note something	In addition to playing, pausing, or rewinding a 360° video, users can change their point of view. However, none of these interactions is

	significant that they would not otherwise have noticed using 2D media. For instance, hazards behind them.	captured. 360° media need to be combined with other instructions to be used in the assessment process. Like 3D media, the cost of producing 360° media is now very affordable.
3D 360°	Combining 3D and 360° media does not add anything fundamentally different to each medium taken separately other than making the experience more engaging.	3D and 360° media need to be combined with other instructions to make them useful for assessment purposes. Learners also need to wear 3D glasses. The cost of production of 3D 360° is not much more than either of the two media separately.
VR	The great potential of VR is that learners can be immersed in environments that might be dangerous, impossible or too expensive to access in the real world. VR media does require users to have appropriate headgear, which could prove expensive for a group of learners.	Simply being immersed in a virtual environment does not produce assessable material. However, when a VR environment is manipulated with input devices, the users' interactions can be recorded, and these can be used for assessment purposes. It is possible for more than one learner to interact with a VR environment at the same time, so it is possible to assess group work. The challenge is to be able to produce VR environments that can record user input affordably.
AR	Augmented reality may be more beneficial in the learning process than either 3D, 360° or VR. When AR is combined with these media it is even more beneficial as learners need to interact with the media and not just view them (e.g. answer questions, change parameters using virtual controls).	Learner interactions in an augmented reality environment can be captured and stored then used for assessment purposes. The challenge is to design and build suitable interactions in an environment that is reliable and valid.
MR	The same points made for 3D, 360° and VR apply to MR.	The same points made for 3D, 360° and VR apply to MR.

S and B Automotive Academy - VR paint spraying

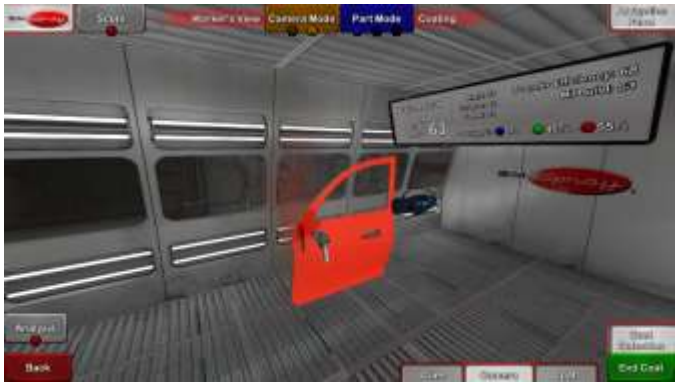
S and B Automotive Academy, based in Bristol, provides a wide range of apprenticeships to young people in the automotive industry from across the UK. Paint spraying forms a part of many of the apprenticeship routes they offer. Paint spraying is a challenging skill to teach because the paint spray has to be contained in a sealed environment with extractors. Anyone in the spray booths needs to wear an air-tight suit with an air supply. In a traditional teaching scenario, a group of learners all wearing airtight clothing would need to be assembled inside the spray booth. At the same time, the instructor wearing the same protective clothing needs to explain the principles to the learners. In this environment, it becomes very difficult for the learners and the teacher to hear each other and for teachers to observe practical spraying demonstrations. Paint spraying requires a high level of skill which cannot be easily demonstrated and takes time to learn. The problem with this approach is that it is costly in terms of the large amount of paint required and the frequent replacement of parts for spraying.

In 2014, the Academy invested in a commercial VR paint spraying simulator called SimSpray to try to improve the quality of the teaching and learning experience. SimSpray was originally developed to train employees in the automotive industry and not specifically for use in the vocational education sector. However, it is has become a valuable teaching and learning tool for the Academy.

SimSpray is a very powerful tool and can simulate all aspects of carrying out physical paint spraying. Users can configure it to simulate different types of paint spraying technology and different spraying techniques, and they can also select the type of object they want to spray, for example a car or lorry part. When learners put on the VR headgear, they see a 3D representation of the part to be sprayed in a virtual paint booth. The equipment comes with specially adapted spray guns that pick up the movements of the user and provide an authentic vibration feeling. The picture below shows someone using the SimSpray VR system with the headset and spray gun.

SimSpray console and user wearing the VR headset and the specially adapted spray gun

Stefan Taylor, the tutor at the Academy responsible for teaching paint spraying, starts all his learners with SimSpray before they try doing any real paint spraying. When learners put on the headset they are placed in a virtual spraying booth as shown here:



Screenshot of what someone wearing the VR headset sees when using SimSpray

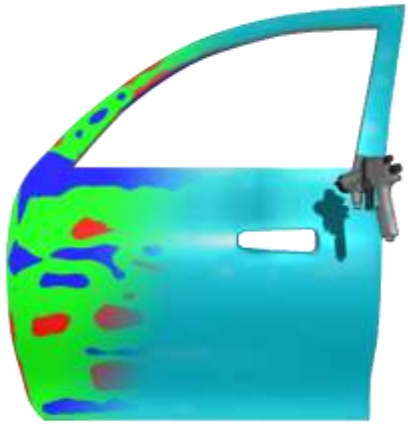
The simulator provides a very authentic experience, using a real spray gun, but without paint. The sensors track all movements and record the distribution of paint on a component exactly. SimSpray enables teachers to set up lessons for learners that guide them through a recommended sequence of lessons and keeps track of which lessons they have passed or attempted. Lessons are organised into courses that focus on specific painting processes and degrees of difficulty. Each lesson includes a target score that learners must match or exceed in order to pass.

Each learner takes it in turn to spray the same part. The learner wearing the headset sees the part to be sprayed in 3D, which is also displayed on a large screen for all others to observe. Stefan is able to coach each learner on their technique, whilst the others look on and note the same advice.

After a component has been sprayed, SimSpray provides an analysis of the quality of the workmanship, indicating:

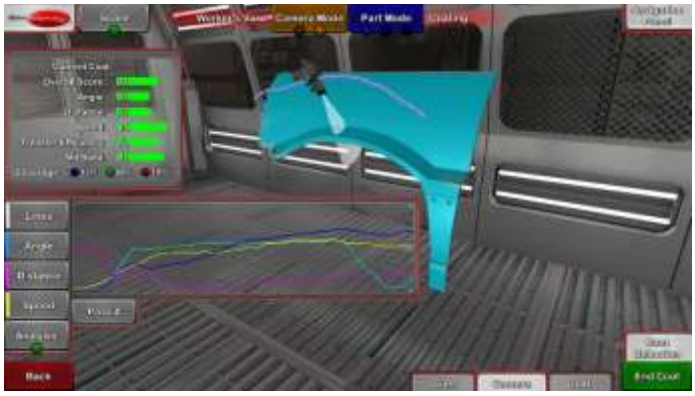
- How much paint was wasted;
- The variation in the thickness of the paint across the part; whether it was too much and too little;
- Any defects; and
- Air pressure and flow, distance, speed and angles.

SimSpray overlays the panel with red, blue and green to illustrate the quality of the work as shown in the example below. Green areas are correct, blue areas indicate too little paint and red areas too much paint or defects.



SimSpray's display of a sprayed door panel, illustrating the quality of the spray work.

SimSpray also enables the teacher to display an outline of the movements that the spray gun has made so the learner can see how their technique has led to faults, as shown in the pictures below.



SimSpray display showing the path of the spray gun

SimSpray also has a playback facility so that Stefan can review the performance of each learner. Apprentices come to the Academy in cohorts of between five and twelve for a few days at a time, so they get plenty of opportunities to use SimSpray. As the simulator produces a score of competence for each learner, Stefan occasionally uses it for competitions between learners, who may see it as a video game, but it does drive them to improve their skills.

Although SimSpray is only used for formative learning, Stefan and the learners say that they are better prepared for learning how to use the real paint spraying equipment and perform the associated assessments. It is very unlikely that the awarding bodies would accept the performance of a learner in a VR simulation as evidence of competency, whatever the practical skill is being assessed. However, VR could be used for summative assessment where it is being used to demonstrate underpinning knowledge.

The disadvantages of using a VR system like SimSpray are the high initial cost of the equipment and the associated training of teachers. However, this needs to be balanced against the long-term savings in paint and the reduction in time it takes to teach learners to understand the fundamentals of paint spraying so that they can be formally assessed sooner than would otherwise be possible.

> *'The simulator really made a difference when you do the spraying for real, it made you much more confident.'* Paint spraying apprentice

Llandrillo College – Virtual body

The Health and Social Care department at Coleg Llandrillo invested in six Oculus VR headsets in 2018. Oculus includes Sharecare VR, an anatomically accurate 3D model of the human body, its organs and their natural functions. Sharecare VR enables learners to enter and explore various elements of the human body. The course unit called 'Human Body Systems' on the Level 2 Health and Social Care course requires learners to be able to describe particular health conditions. Therefore, it was important for the VR software to provide learners with the ability to observe the effects of certain health conditions on the organs and systems of the body, for example the effect of asthma on the lungs.

The VR system mirrors the view of the person wearing the headset onto screens that the rest of the class can see. This means that the teacher, Kate Farmer, can ask all learners questions about what is being observed. Learners find the VR facility very engaging and it helps them to write up their unit assessments with more clarity. The learners work in small groups to share the use of the six headsets.

Kate Farmer wearing the Oculus headset and using the touch controllers to interact with and move through the virtual body. The screen displays a 2D view of the image seen by those wearing the headset.

2D view on a TV screen of a stent in a blood vessel inside Sharecare VR

From September 2019, Kate will start using the VR system for summative assessment by setting up particular scenarios in the VR human body and then asking learners specific questions that satisfy the assessment criteria.

The main challenges for the College in adopting VR in the curriculum have been:

- The initial investment;
- Making sure that they have the right VR applications to match the needs of the curriculum; and
- Developing staff skills so that they are confident to use it with their learners.

Preston College - Use of 360° videos

Preston College has been working on affordable AR and VR opportunities in the curriculum for the past two years. The main motivation was the need to improve certain aspects of teaching and learning. In their last but one inspection, the College dropped to a grade three and was criticised for not providing enough formative assessments for learners and for the failure to provide more 'stretch and challenge' opportunities for more able learners. The College made a number of improvements, including, trialling the use of AR and VR applications in a number of curriculum areas including their use with performing arts, dance and drama students. The challenge with these learners was to capture their fleeting movements and their interaction with others so that they could reflect on their performance and observe afterwards how they use their own space and interact with each other.

By recording the dancers or actors with a 360° camera in their midst, the learners can review the footage afterwards from any angle to see how they move through space and how they relate to one another. They can 'freeze frame' to look at their own backs and zoom in and out at angles not available to them in any other way. Following a 360° recording of a performance, the teachers and learners review the 360° video to identify good and bad aspects and suggestions for improvement. For learners to be able to obtain distinction grades they need to demonstrate the capacity to reflect on their performances, which is not easily achieved with static photographs or conventional 2D video but much easier with 360° video.

The teacher noted:

"The clarity and richness of the feedback from the 360° videos both astonishes and stimulates learners to reach beyond what they thought was possible. This motivates them to improve and supports them to achieve 'outstanding' rather than just 'good' grades."

This link takes you to a 360° video of the dance students on YouTube:

https://youtu.be/2268WpP_xHA

Conclusions

VR holds great potential in vocational education for the teaching and formative assessment of practical skills. However, awarding bodies could consider the extent to which VR could provide opportunities for the summative assessment of practical skills. There are, also, many opportunities for using VR in the summative assessment of underpinning knowledge. The challenges for the adoption of VR in the curriculum are not only the cost of the equipment but more importantly, the cost of developing relevant VR models and environments.

Perhaps it is more realistic to use augmented reality, 3D and 360° video technologies in vocational education as the cost of these is low and they are more easily mastered. The challenge lies in moving on from using these technologies to support the learning process to using them for assessment purposes.

Use of e-Portfolios in assessment

e-Portfolios are now commonplace in work-based learning because of the significant benefits they afford learners, teachers, assessors and the whole organisation. In their most basic form, e-Portfolios are simply online storage places for learners to save all the digital material related to their qualification, not necessarily in any structured way. However, e-Portfolio platforms can also provide a range of additional features such as:

- Tools to build the qualification frameworks that reflect each element of their assessment patterns, e.g. 'the learner must be able to read a micrometer correctly';
- Pre-built qualification frameworks for most of the awarding bodies' work-based qualifications;
- Functionality enabling learners to upload their evidence mapped to the relevant criterion;
- Functionality enabling teachers/assessors to 'check-off' that submitted evidence meets/does not meet criteria;
- Tracking and monitoring of learners' progress, including reporting;
- Inbuilt internal quality control processes and support for external verification;
- A learning environment to create and deploy online courses and learning content;
- A notification system for all transactions between users (e.g. an automated email notification that a learner has submitted some evidence);
- A communication system enabling users to send messages to each other;
- Associated smartphone apps;
- Offline capabilities when there is no Wi-Fi or network coverage; and
- Integration with other systems (such as organisation management information systems)

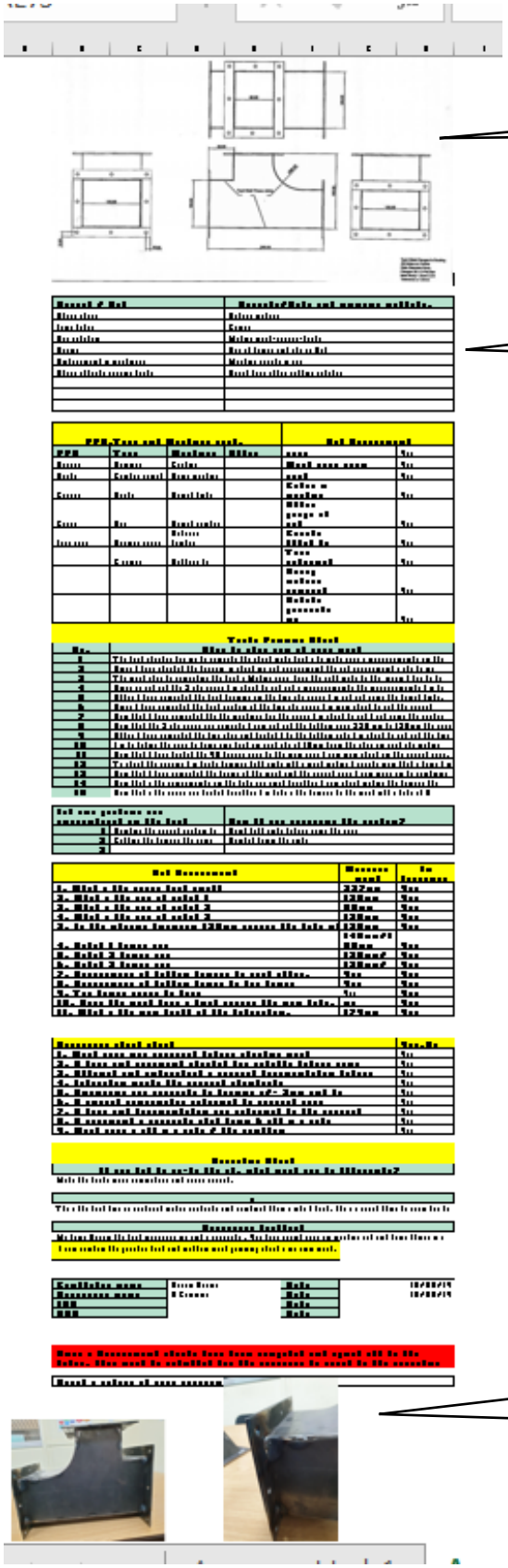
The benefits of using e-Portfolios include:

- The convenience for learners to manage their work and collate their evidence;
- The efficiency with which teachers and assessors are able to keep track of the progress of each learner;
- The ability for managers to oversee the performance of individual staff or teams of staff;
- Interactions between learners and assessors do not need to take place in real time;
- The reduction in the number of visits to learners' workplaces; and
- The improved efficiency of the quality control process.

Coleg Cambria Google Classroom and Google Sheet

Each year, the four welding tutors at Coleg Cambria have the challenge of collating a portfolio of evidence for each of the 100 or so learners studying for welding qualifications. Prior to the current initiative, each learner had a physical portfolio in which progress was recorded and evidence collated (written statements, checklists and photographs). With such a large number of learners, pieces of evidence would be mislaid, and the process was time consuming. It was difficult to tell if a learner had completed all elements and there was no overall progress tracking of the whole cohort. Coleg Cambria moved across to using Google Classroom several years ago, which provided an opportunity to move wholesale to e-Portfolios

One of the tutors, Tony Commins, creates a spreadsheet using Google Sheet that includes the details and instructions for each element of assessment in the qualification as shown here:



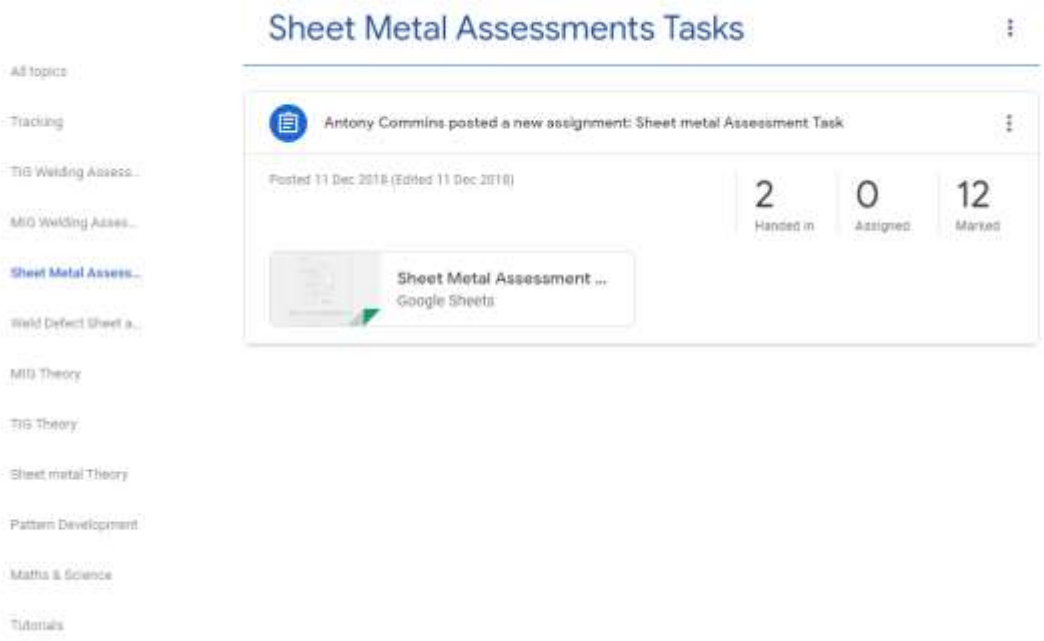
Artefact to be produced

Questions to be answered by selecting the correct value from the dropdown box

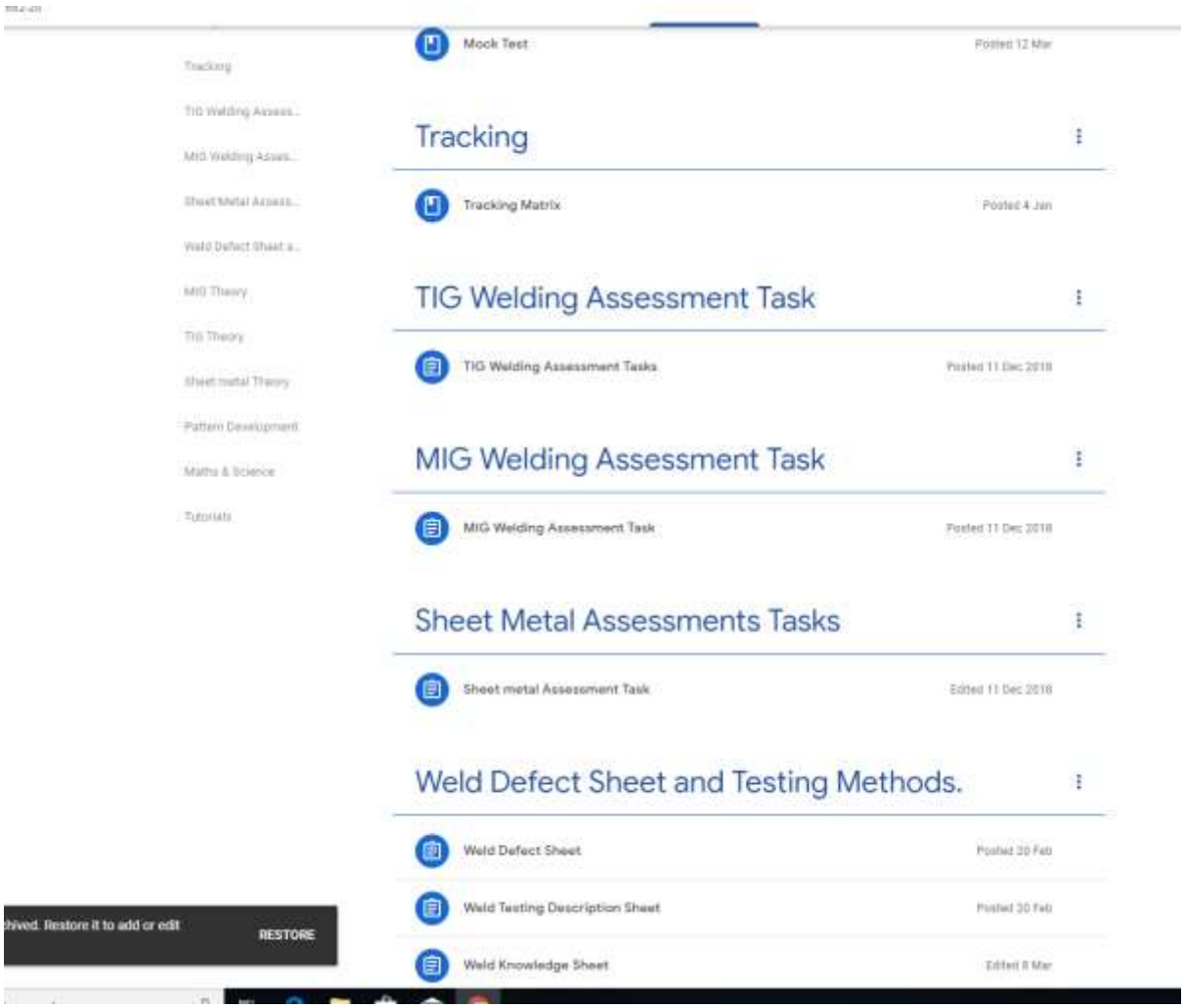
Uploaded pictures taken by the learners of their work

Google Classroom enables educators to cascade a copy of the assessment spreadsheets into each of the learner's folders. Learners answer the questions in the spreadsheet and upload any required

evidence such as photographs of their practical work. Learners complete all the questions included in the assessment sheet by picking the correct options from dropdown boxes. When learners have completed an assessment sheet, they submit it via Google Classroom, which records the submission and notifies the tutors as shown here:



Google Classroom tracks all of the work for each learner as shown here:



The external verifiers are able to access the digital portfolios rather than browse physical portfolios. Coleg Cambria has also implemented a system for digital signatures so that the verifier can be confident that there is an internal quality control process in place.

This approach has resulted in a number of benefits for tutors and learners. For the tutors, it means that the learners' portfolios of evidence are logically stored in a digital format that cannot be lost. Learners have control over their work and can work on their portfolios remotely, at work or at home.

This is an example of a solution that was developed in-house rather than a commercially available platform.

Vocations Limited – OneFile e-Portfolio

Vocations Limited is a private training provider based in Swansea which specialises in supporting learners and apprentices in the travel agency business across Wales. The main qualifications they offer include level 2 and 3 NVQ Certificates and Diplomas in Travel Services. Until 2018, Vocations Limited used a mix of physical portfolios of learners work and e-Portfolios. However, in 2018 they moved entirely to using e-Portfolios. Vocations Limited are subcontractors to two prime contract holders, Torfaen Training and ALS who use the e-Portfolio platforms OneFile and VQ Manager,

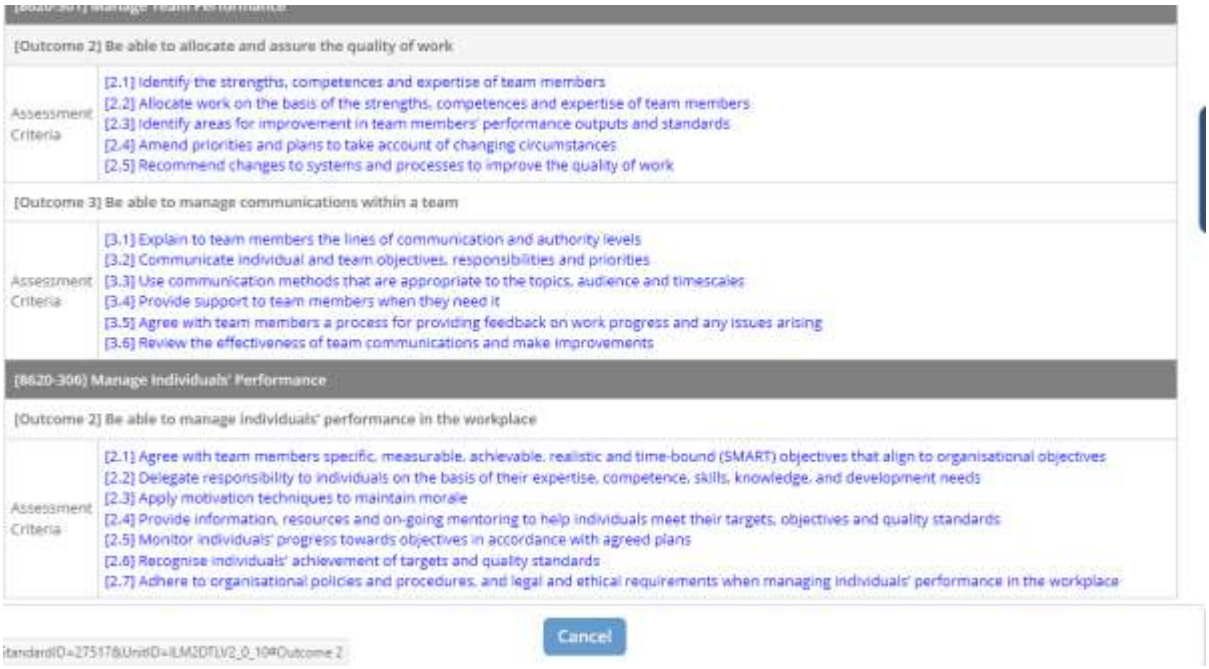
respectively. In the beginning, a small number of learners, generally older ones, were not comfortable with moving over to using an e-Portfolio platform but this is no longer the case.

When Vocations limited assessors meet with learners for the first time they conduct a training needs analysis (TNA) to identify the units learners will study and determine the most comfortable way for them to submit their evidence.

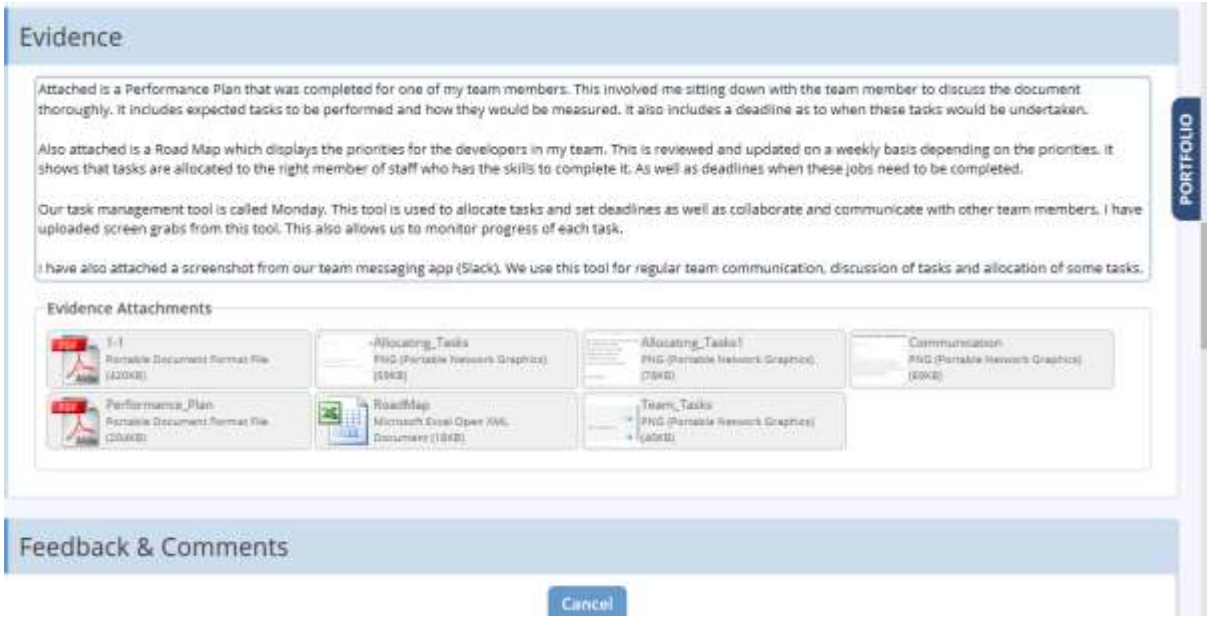
Vocations Limited e-Portfolio platforms provide the following functionality:

- Record tracking each learner's progress on their qualification, indicating which elements they have completed and those that still need completing;
- The facility for learners and assessors to store and collate evidence related to each element of the qualification. This might be written, typed or scanned documents, pictures, videos, audio recordings, answers to specific questions, results of tests and examinations;
- A means to record all communications between learners, assessors, employers and anyone designated in a quality assurance role;
- A notification system to inform all those with accounts when a change occurs, for example when a learner has uploaded some evidence, or an assessor has fed back on a piece of work; and
- A diary function to manage review meetings and any other event.

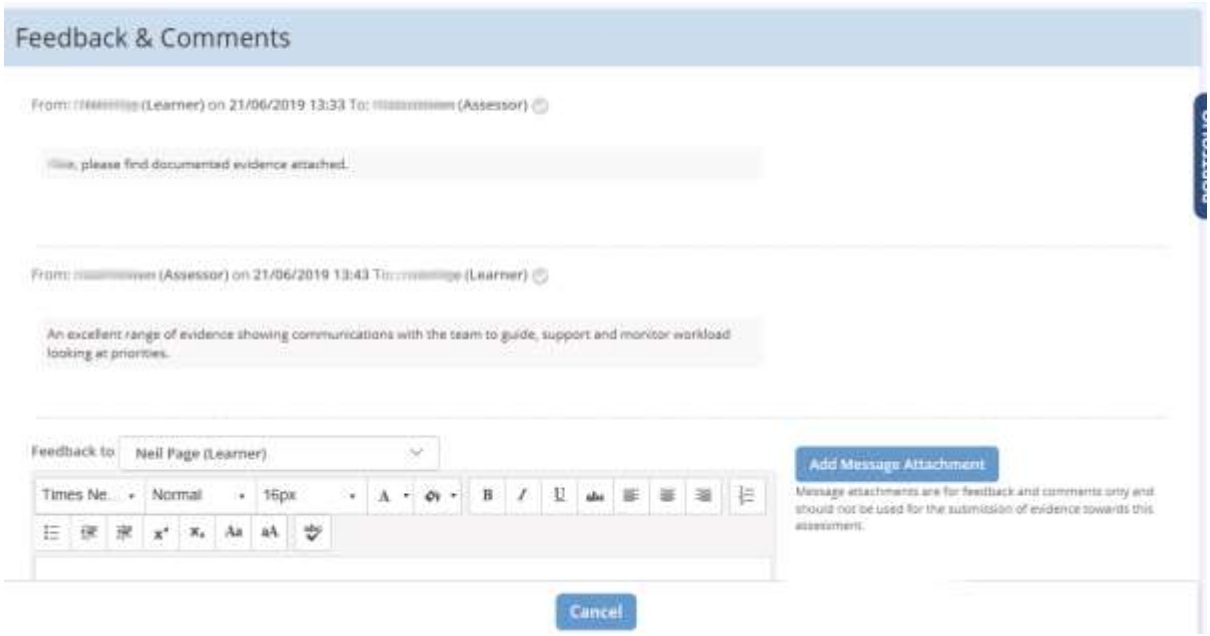
The screenshot below shows a fragment of the list of learning outcomes and associated criteria for one of the courses supported by Vocations Limited.



Each of these items (in blue) can be clicked to see what evidence has been uploaded by the learners and their justification for why they have achieved the relevant criterion, as shown here:



The assessor is then able to provide their feedback as shown here:



The TNA indicates the learners' preference for the format of the evidence they want to use with the e-Portfolio platform. This may be handwritten, scanned or a typed document. Assessors can also prompt learners with questions to which the learners type their responses directly into the e-Portfolio platform.

A popular way for Vocations' assessors to collect evidence is through audio recordings of interviews with learners. Vocations' assessors use either their own smartphones or laptops to carry out recordings. Assessors ask learners questions related to criteria in the qualification and record the learners' responses. This approach seems to be more efficient than other means. Interestingly, this approach is popular with managers but not with more junior staff. Learners who are managers tend

to be more confident in responding verbally and find the verbal interviews take less of their time. More junior staff tend to be less confident and prefer to respond with written evidence.

Benefits

The key benefit for Vocations Limited in using the OneFile e-Portfolio platform is the way it manages the whole assessment process, reducing the administrative burden, which is important for a small learning provider. Learners are often motivated to see their progress and the percentage completion of their qualifications. Prior to the use of OneFile, assessors would meet learners once every five weeks and much of the assessment would take place then. The use of OneFile has meant that the assessment process is now continuous, with learners submitting work at any time of day or night. Assessors still meet learners once every five weeks, but now all they need to do is make sure that all learners' work has been dealt with, in advance of the meetings. This has required assessors to manage their time much more effectively.

Technology

e-Portfolio platforms like OneFile tend to be cloud-based, so there is no need for learning providers to install and maintain any applications on their own systems. Vocations Limited assessors are all equipped with smartphones and laptops so that they can work remotely. All laptops are also fitted with phone cards to provide them with internet connectivity wherever they are in Wales.

A quality manager's perspective on e-Portfolios

Helen Harris is the quality manager at Wales England Health Care, a work-based learning provider working across Wales and England. Wales England Health Care is a subcontractor to two prime contractor holders in Wales and two in England. Wales England Health Care support apprenticeships at levels 2, 3 and 5 in health and social care for adult learners. Helen's role is to oversee the quality of all of Wales England Health Care provision, which involves monitoring both internal quality and liaising externally with the awarding bodies (Agored and Pearson).

There are the usual benefits associated with using an e-Portfolio platform for learners and assessors; however, there are also two significant benefits from a quality perspective. Firstly, Helen is able to run reports, per learner, cohort, assessor, employer and prime contractor. These reports enable her to intervene and advise on policy decisions. Secondly, the prime contractors can log into Wales England Health Care's e-Portfolio system (OneFile) themselves and examine the performance of their learners. This means there is no need to compile and despatch separate reports for each contractor. Likewise, the awarding bodies can log in and do the same. Wales England Health Care has encouraged employers to monitor their learners by logging in, however, there has not been much take-up of this facility.

Helen has not identified any downsides to using their e-Portfolio platform and says that she could not imagine working without it.

Use of cloud authoring and sharing in assessment

Over the last fifteen years, new functionality has evolved in web-based applications that enable people to share, collaborate and co-author in common spaces on the Web. The common space may take the form of a document (e.g. text, a spreadsheet, or a graph) or new unique forms (e.g. canvasses, whiteboards, and circuit diagrams). This functionality gives learners the ability to work on the same assessments at the same time, even when they are remote from one another. Cloud-based platforms also mean educators can provide learners with dynamic feedback or summative grading at the same time learners are working on their assessments. Some of the potential benefits are as follows:

- The immediacy of transactions — no need for printed work to be submitted, marked manually and returned;
- Learners and teachers can be remote but still work concurrently;
- Teachers can see the evolution of work and monitor for learners' misconceptions or persistent errors over time; and
- There is no danger of versions of documents becoming out of sync, for example when a learner responds to a teacher's comments but on an earlier version of a document, rather than the most recent version.

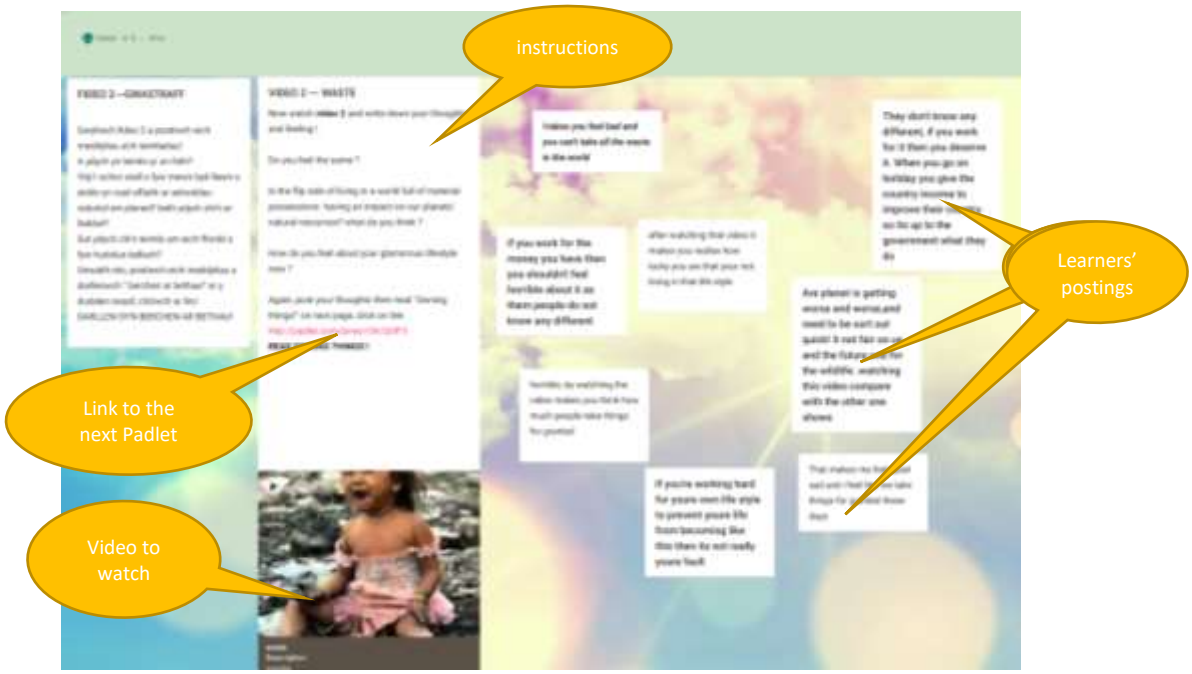
Perhaps the two most commonly used platforms in vocational education are Google Education and Microsoft 365 both of which enable users to work on word-processed documents, spreadsheets and presentations. Formative or summative feedback that is given via a cloud-based platform can include richer media, including video, audio and animation.

Examples

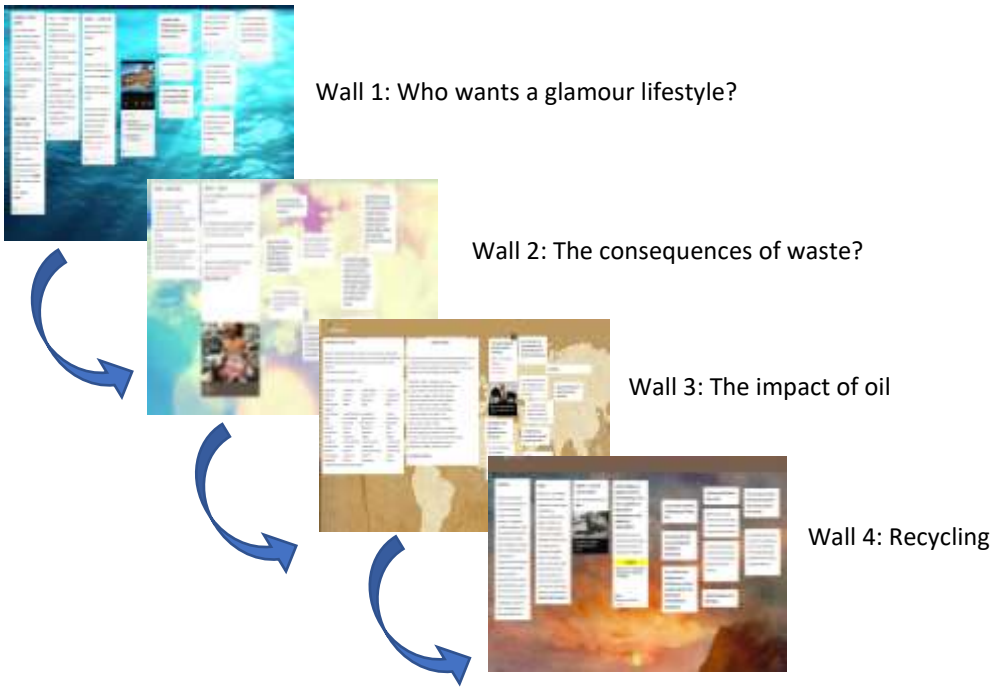
The examples presented here demonstrate how cloud-based platforms are being used in vocational education in a range of different settings and approaches.

Education for Sustainable Development and Global Citizenship (ESDGC) virtual whiteboards

As with all learners in Wales, work-based hair and beauty learners at Coleg Menai need to develop an appreciation of the principles and issues related to sustainable development and global citizenship. Teaching subjects such as ESDGC outside of the learners' main programmes of study can be challenging for providers who have limited time to spend with their learners. Karen Walker-Jones, WBL team leader, has developed a cloud-based solution that enables learners to study ESDGC and express their understanding and feelings on the subject matter by posting to a virtual whiteboard. Karen's solution is based on Padlet, one of several platforms that enable multiple users to contribute simultaneously to a shared space online.



Karen has created four virtual Padlet whiteboards or 'walls', daisy-chained together via hyperlinks. Each whiteboard has a video clip embedded, instructions, and the link to the next wall, as shown here:



Wall 1: Who wants a glamour lifestyle?

Wall 2: The consequences of waste?

Wall 3: The impact of oil

Wall 4: Recycling

Learners visit each wall in turn, watch the embedded video and then post their thoughts and feelings to the same wall. The instructional sequence behind the four Padlet walls is shown below. The walls are designed to get the learners to first think about the consequences of their lifestyles (desired or real) on the environment and then think about what positive actions they can take to change things for the better.

Although this work is not formally assessed Karen reviews the learners' posts to ensure that they have understood the intended learning outcomes. Karen uses the four Padlet walls in a classroom setting; however, the benefit of this approach is that she can use it with work-based learners who are able to access the walls in their own time. Karen also uses Padlet as a tool for getting feedback from learners on their learning experiences at the College.

Use of Office 365 and OneNote Class Notebook at Cardiff and Vale College

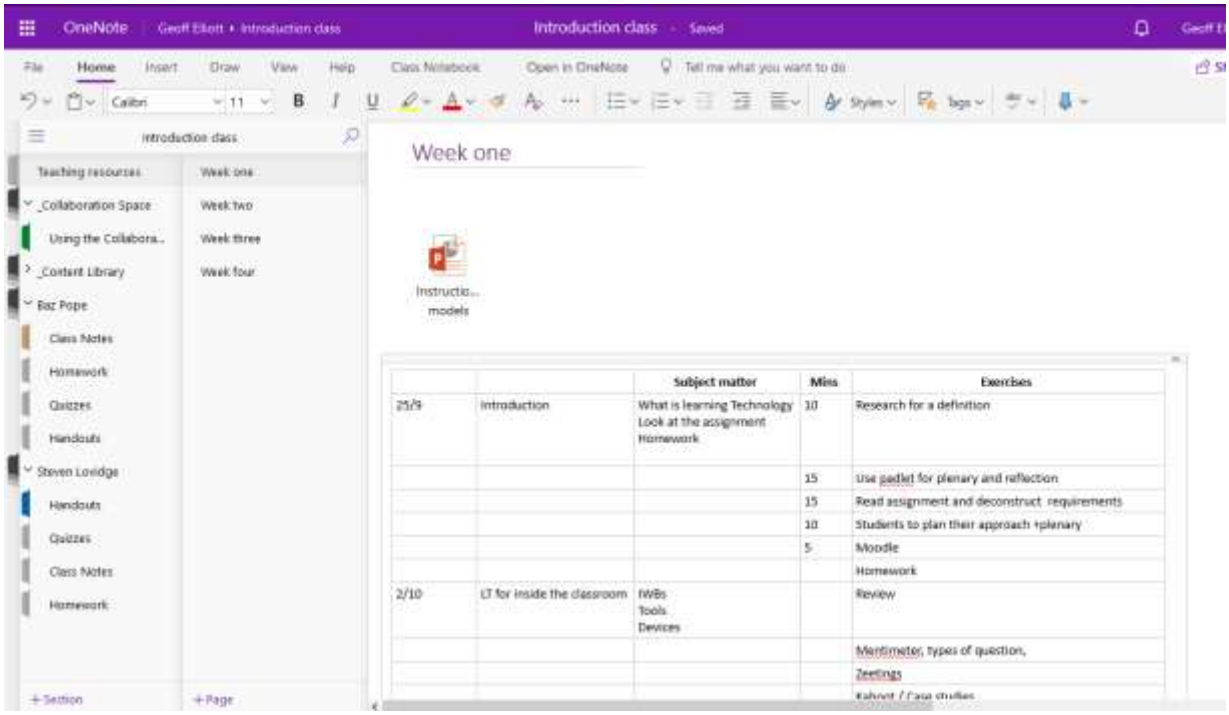
In 2017, Cardiff and Vale College (CAVC) launched a digital leader programme to enhance teaching and learning with technology and improve learners' digital skills. Rio Judson was appointed the digital leader for the ESOL (English as a second or foreign language), ABE (Adult basic education) and LearnDirect department. The department has about 2000 learners of which 1400 are enrolled on ESOL courses. In this same period, CAVC standardised on the cloud-based Microsoft Office 365 suite of tools and applications to support teaching and learning across the College.

In 2017–18 Rio decided all ESOL and ABE classes should have a Microsoft Office 365 Class Notebook. Rio set a minimum requirement for staff to use Class Notebook for their course files but also encouraged them to use it for blended learning. Some staff simply used it to post their records of work and associated resources, whereas others used it more extensively as an interactive tool for learners' work and assessments. Training and support were provided for staff to gain confidence and experience in using Class Notebook.

The department developed a set of digital skill standards with a structured suite of learning objectives for all learners from entry level one to level two. Although these objectives are outside of the formal assessment for ESOL qualifications, they were seen as necessary to ensure that ESOL learners were equipped with the necessary digital skills for the 21st century, especially online communication.

Class Notebook is a cloud-based space shared between teachers and their learners. Like a physical notebook, Class Notebooks are structured into pages that are contained in sections. Unlike a physical notebook, a user can add as many new sections and pages they like, move them around and delete them. Pages can contain multiple media types — text, images, videos, hyperlinks, handwriting (using a digital stylus), tags and many other objects. This means that teachers and learners can post material that all learners can then see and potentially edit. Watch this video to gain a better understanding of Class Notebook.

https://support.office.com/en-us/article/video-class-notebook-for-onenote-for-windows-10-8e9fcec7-17e7-4fb8-9e2d-4757b8a5abe6

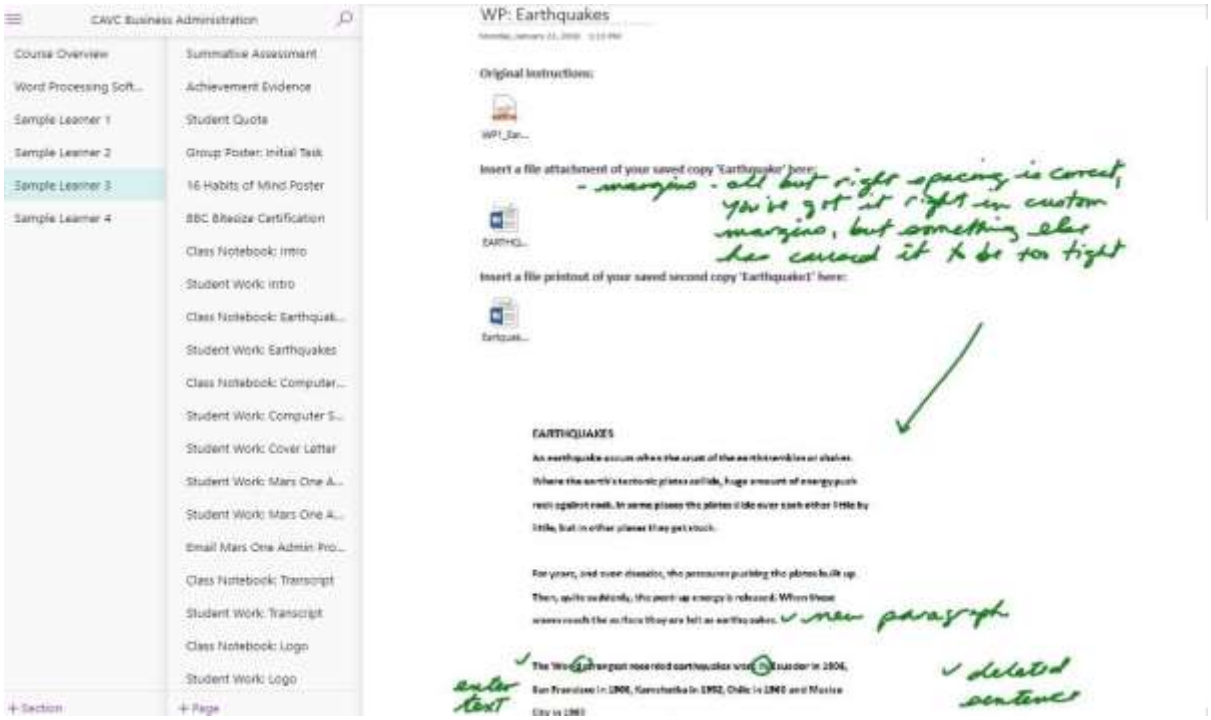


An example Class Notebook, showing the sections on the left, and the pages within each section to the right. In this instance, the user has clicked onto the 'teaching resources' section and the page 'week one'. Also shown are the named sections for each of the two learners.

Each Class Notebook generates a separate section for each learner to which they can add pages and edit as they wish. Teachers can create an assignment and then 'distribute' a copy to each learner's own section. As the learners begin to work on their assignments, the teacher can see how each student is progressing and if necessary add their comments.

The Office 365 suite also includes the applications Teams and Flipgrid, both of which are used in the ESOL and ABE department. Teams is a cloud-based platform that combines messaging, video meetings and file storage and Flipgrid enables teachers and learners to respond to each other via recorded video clips rather than text or voice.

One assessment of the level one ESOL+ Business Administration qualification requires the learners to work in small teams to develop the brand and promotional materials for a mock business start-up, including business cards, leaflets, posters and other items such as an 'elevator pitch' video recorded with learners' own smartphones. Using Class Notebook meant that learners could upload their work to Class Notebook, at any time or place, independently of each other.



A separate Class Notebook created for the external verifier to review learners' work. In this instance, the section for 'sample learner 3' has been opened to show a page of the learner's word processing work. The teacher has annotated the work with a digital stylus

The main benefit for Rio in using Class Notebook is the convenience of managing the learners' work; historically, learners work would need to be stored in large physical files. The main benefit for learners is that they can work on assignments from anywhere with an internet connection and communicate with their teacher. Learners and teachers can share many different types of rich media, such as videos, through Class Notebook. Learners can also work on group activities without needing to be in the same physical location at the same time. Another important benefit for learners is the experience of working with a sophisticated cloud-based collaboration platform which is something that they are likely to use when in employment.

Use of Office 365 Teams in the assessment process at South Lanarkshire College

South Lanarkshire College has been using the Moodle VLE for all course notes and teaching materials for a long period. However, Office 365, which has recently been made available to learners and teachers, is now beginning to be used for assessment purposes. Joan Bell, a lecturer in travel and tourism, has been using the Office 365 application called 'Teams' to help in the assessment process, particularly for group or project-based work. As described above, Teams is a cloud-based application that enables users to create shared workspaces with others where they can share and work on the same documents, use chat facilities and video conferences to communicate, and plan activities using a shared calendar. Teams now allows teachers to distribute assignments, set deadlines, provide feedback and then grade learners' work.

Joan now sets deadlines in Teams for her level 5 (level 2 in England and Wales) learners to submit their final pieces of work but she also encourages them to submit draft work so she can then provide feedback as their work progresses. Learners can access their feedback anywhere, provided they have access to the internet.

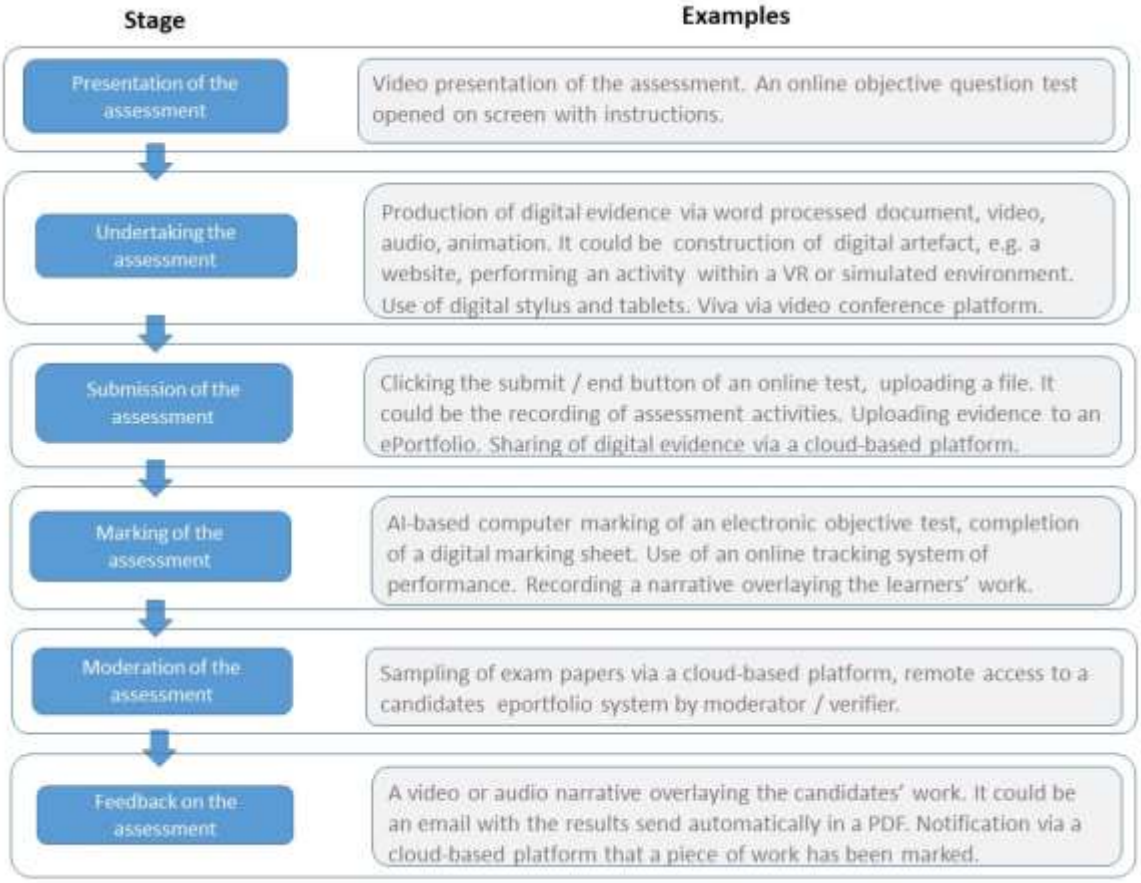
Joan has used another Office 365 cloud-based application called 'Sway' that enables users to create online presentations. Joan directs one of her lower-level groups to produce a presentation using Sway for one of their units on software applications. Sway is different from PowerPoint in that the finished work can only be accessed from the cloud. So, learners simply include a link to their Sway presentation in their assignment submission in Teams.

Teams is particularly good for group work, for instance, Joan gets her learners to set up their own Teams sites when completing their employability skills assessments. Once the learners have set up and named their Teams sites, they can coordinate their activities, dividing the work amongst themselves and then uploading it to the shared Teams site. Learners can even work on the same document at the same time. The learners need to include Joan in their Teams sites so she can assess the work once complete.

Using Teams makes the verification process more straightforward because internal and external verifiers can also access the learners wherever they are located.

Summary

All the examples that have been provided can be attributed to one or more of the stages of the assessment process as shown in the diagram below. However, only a few examples in this report illustrate the use of technology in the stage of undertaking the assessment.



The stated benefits of those who have provided these examples have tended to be either about improving efficiency, improving the learners' experiences or both. The stated challenges tended to

be either the practical or technical implementation issues. None of the participants in the research stated any concerns about the validity of new technology-based approaches to assessment.

Most of the examples were related to formative rather than summative assessment. This study did not investigate why this was so, but possible reasons include:

- Educators judge that the use of technology introduces an unacceptable level of risk into the assessment process, the key risk being the reliability of the technology.
- Lack of time for educators to develop reliable and valid technology-based forms of assessment.
- Lack of technical skills to develop suitable technology-based assessments.
- Awarding bodies may be reluctant to endorse the use of more technology in their qualifications without conducting rigorous piloting first.
- Lack of awareness and imagination of what is possible with technology.

Further research

The attitude of educators to the role of technology in assessment could be explored to ascertain the extent the reasons suggested above play a part or whether there are other reasons. It would also be helpful to understand what strategies and plans the awarding bodies' strategies and plans have for the exploitation of technology in the assessment of their qualifications. The question of why there were so few examples of the use of technology in the undertaking of assessment also requires further study.

Acknowledgements

We would like to thank everyone who submitted their examples of the use of technology in the assessment of vocational qualifications. We would also like to thank the organisations that shared details of this study with their members, including JISC, the Blended Learning Consortium, NTFW, and bWBL.

Appendix List of examples submitted

Title of example	Learning Provider / Organisation
Cloud-based activities	
Digital Culture - Social Software – use of Cloud-based authoring tool to create a presentation	South Lanarkshire College
ESDGC Padlet Wall Consumption and Waste. Shared cloud-based digital 'walls'	Coleg Menai
Flipgrid. Production and sharing of cloud-based videos by learners	Gwent College
Google docs as no Microsoft Word	Semta Apprenticeship Service
Spark (Adobe). Learners portray their research as part of their digital literacy qualification	Babcock International
Use of Microsoft Online for Peer Collaboration	Pembrokeshire College
Using Class Notebook for BTEC electronic portfolios	CAVC
ePortfolios	
EILP developed through Classroom and GOOGLE Sheets	Coleg Cambria
City and Guilds Learning Assistant	NPTC Group of colleges
Use of SmartAssessor system (ePortfolio)	Itec Training Skills and Employment
The use of ePortfolio system One File	Wales England Care
One File E-portfolio system and digital review transfer	Wales England Care Ltd
Organisational use of OneFile ePortfolio system	ACT
OneFile	Torfaen Training
Travel Agent Technology Onefile	Vocations Ltd
Use of Mahara Portfolio and marking in Moodle	Sparsholt College
Screen recording for summative and formative assessment.	Pembrokeshire College
Using Video Screen Capture Software to give Video and Auditory Feedback on Assignments	Coleg Cambria
Learning Management systems	

Moodle	Gower College Swansea
Moodle grade tracker electronic marking summarise feedback of sports massage practical sessions	Pembrokeshire College
Online assignment submission, plagiarism checking, marking, annotation, feedback and grade collation.	Gower College Swansea
Quiz-based activities	
Kahoot formative assessment	Coleg Llandrillo Menai
Online Questionnaires / Forms. enabling learners to complete the necessary assessment criteria	LMJ Training
Use of Kahoot it as a checking method for learner knowledge	Babcock
Use of self-marking spreadsheet	CAVC
Using O365 forms to create quizzes/tests for formative assessment	Coleg Gwent
Resources	
EdPuzzle, interactive video lessons	Coleg Cambria
Eg 1 - Chrome books, using a variety of platforms / tools and Apps of which NearPod is used to support assessment in the Traineeship route	Itec Training and Skills
Embedded video in Assignments	Coleg Sir Gar
Maths video	Babcock
Online presentations	Babcock
Practical resources for professional Chefs, designed and delivered by professional Chefs	Cambrian Training
Using Youtube to enhance training	Clybiau Plant Cymru
Synchronous working	
Synchronous and asynchronous collaboration within the EDLS	Cambrian Training
Using the OmniJoin Conferencing Client instead of physcial client visits	Aspiration Training
New Media	
use of 360 technology to record practical skills	Preston College

Simulated Paint spraying	S and B Automotive Academy
Use of virtual reality human body software	Grwp Llandrillo Menai
Use of VR in to simulate and accident and emergency situation	Sollihull College
Virtual Welding	Weldability Sif
Video and audio evidence capture	
Remote capturing of learners' work via Google Slide and smartphones	Coleg Sir Gar
Analysing rugby and football via screencasting	Gwent College
Assessing student learning preferences	Coleg Sir Gar
Coach my Video to support hair dressing skills	Coleg Menai
Digital Voice Recorders	Clybiau Plant Cymru
Digital Voice Recordings	Wales England Care
Effective use of DVR recording during assessment.	Sirius Skills
Self-assessment through use of Screencastify	Coleg Sir Gar
Miscellaneous	
College App (West and Etrack), Google Drive - Photos and videos, social media	Colegsirgar
Duke of Edinburgh e-badges	CAVC
Level 3 Applied General Diploma in Art & Design	UAL Awarding Body
Tracking system with QR codes	Coleg Menai
Digital Assessment Feedforward	City of Glasgow College
Principles and Practice of Assessment	City of Glasgow College
Understanding assessment in education and training	City of Glasgow College