Are virtual visits an effective way of engaging learners?

Keywords: virtual visits, widening participation, webcasts, distance learning
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Executive Summary

Insight visits and field trips have wide ranging benefits to higher education students including reinforcing and expanding upon taught learning (Jakubowski and Marie, 2003; Streule and Craig, 2016), improved ability to relate theory to practice (Elkins and Elkins, 2007), encouragement of social learning (Claiborne et al., 2012), increased sense of belonging to a university community (Fedesco et al., 2011).

Distance learning is appealing to many students due to its potential to fit around their life priorities (Butcher, 2015; Rasheed, 2020). However, circumstances such as geographical location and disability, as well as time poverty caused by factors such as employment, can prevent distance learners from participating in extracurricular activities such as insight visits (Roosmaa and Saar, 2006). An inability to engage with extracurricular activities whilst studying can decrease a student's learning experience and may negatively impact student retention, progression, completion and graduate outcomes (Butcher, 2015; Baxter, 2019).

Advances in technology mean it is now possible to deliver live virtual visits which have the potential to produce many of the same benefits as visits in person. However, the concept of virtual visits has not been fully exploited. Online virtual visits are commonly passive and do not typically provide participants with social learning opportunities. For example, online virtual visits of the Science Museum and National Gallery in London involve use of Google Street View (Science Museum, 2021; National Gallery, 2021). Through utilising interactive technologies which influence the onscreen virtual visit experience, live virtual visits may widen access and participation and enhance distance learner university experience.

The Open University School of Computing and Communications (C&C) has over 15,000 distance learners who are located across the world (Open University, 2021). Many C&C students are interested in the World War II codebreaking that took place at Bletchley Park (BP) and how it relates to present day computing and IT. C&C student demographic data suggests the majority would find it difficult to visit BP museum in person due to geographical location (Open University, 2021). Furthermore, approximately 20% have a declared disability which could further restrict their ability to visit the museum (Open University, 2021).

The aim of the project was to investigate if a live interactive virtual visit to Bletchley Park Museum using onscreen technologies such as onscreen polls, multiple choice questions and a chat box was an effective way of enhancing C&C student experience.

The virtual visit had 164 participants, of which 101 were students from Level 2 C&C modules. Results indicated that 42% of students were identified as residing in the lowest 50% of the index of multiple deprivation and 64% were estimated to reside over 2 hours in travelling time from Bletchley Park. 139 participants interacted with presenters and other participants using the onscreen technologies. Participant survey data revealed that 54% would find it difficult to visit BP in person, yet 100% of

students now want to visit BP in person and 100% of students would participate in a relevant future virtual visit. Student qualitative feedback was positive overall, although some commented they would have liked more time to ask questions to onscreen presenters. It is unclear from student survey results whether the virtual visit enhanced teaching and learning. However, survey results did indicate that the webcast enhanced the participants motivation towards study and their overall OU experience. Reflections from individuals involved in the project delivery found that they felt the virtual visit was successful and that similar visits could be delivered by other organisations, even during a pandemic. However, reflections also indicated that increased audience interaction opportunities were required to ensure the whole audience felt involved in the visit.

Results indicate that virtual visits may be an effective way of exposing students to real world environments that they would normally not be able to access in person. Furthermore, virtual visits may be an alternative promotional strategy for museums and recruiters to increase visitor numbers and diversify talent.

Aims and scope of project

The aim of the project was to investigate if a live interactive virtual visit to Bletchley Park Museum using onscreen technologies such as polls, multiple-choice questions and a chat box was an effective way of enhancing Computing and Communication student experience.

The objectives of the project were to:

- Explore and evaluate the design and delivery process (how can the concept be improved?)
- Investigate the opportunities and limitations (how much value do they provide?)
- Evaluate impact through webcast analytics, student feedback and project stakeholder reflections.

Activities

Although the OU's Knowledge Media Institute (KMi) are very experienced in producing interactive online activities such as labcasts and fieldcasts, they were keen to extend the use of technology and explore the potential of virtual visits to locations such as museums or industry.

The planned activity was to invite all students studying all Level 1 C&C modules to participate in a webcast (J and B presentations). The webcast content and structure were designed to link to Level 1 learning. The initial overall structure of the virtual visit was to visit three different locations at either Bletchley Park Museum or The National Museum of Computing, both of which are located within the grounds of Bletchley Park. The webcast would last approximately 60 minutes, including 2 intermissions while the production crew travelled between locations. Onscreen polls, widgets and a chat box were to be used for quick audience interactions such as polling the audience as to which exhibits in the museum they would like to visit. Use of an online forum during interludes was also planned so that onscreen discussions could be continued during intermissions between participants.

The project team, along with Trevor Collins from KMi, visited both Bletchley Park Museum and The National Museum of Computing in December 2019. The technology and connectivity was tested and worked well in both museums at Bletchley Park. Both museum education leads were very enthusiastic about the general concepts and the technology involved. However, at The National Museum of Computing a decision was needed at a higher level to pursue the virtual visit. Therefore, it was decided to delay The National Museum of Computing virtual visit until a later date and proceed with a visit to Bletchley Park Museum. Bletchley Park Museum were ready to commit, and the education lead, Tom

Briggs, had plenty of ideas on how to bring the subjects of mathematics and cryptography to life. As Tom was the Enigma machine demonstrator at Bletchley Park Museum, and the maths lead in their education department, he was ideally placed to represent Bletchley Park Museum and become an external member of the project team.
Due to the Coronavirus pandemic, many changes to the original plan were made (see 'changes' section) so the webcast was scaled down to last 30 minutes and be in one location. Block B at Bletchley Park was selected, as it has a fascinating exhibition relating to the history of Enigma machines and those involved in the code breaking during World War II. It also has an extensive display of Enigma machines, including one for demonstration purposes.

On the day, the team arrived three hours in advance to set up for the webcast. As this was being completed, the presenters did a rehearsal. The event was not scripted but the running order had been devised to keep structure and timing to schedule (Appendix C). The presenters were ready to prompt each other to keep the webcast progressing smoothly and to ensure nothing was omitted.

At the start of broadcast the map widget was used to gain a sense informally of where participants were participating from (Figure 1).

Figure 1 – Interactive map widget used during the virtual visit to Bletchley Park Museum to gauge participants' locations .

There were over 150 participants, mainly from the UK but several were from further afield.

Throughout the webcast, multiple choice questions were used to test learners' understanding of the content of the demonstration, as shown in Figure 2.

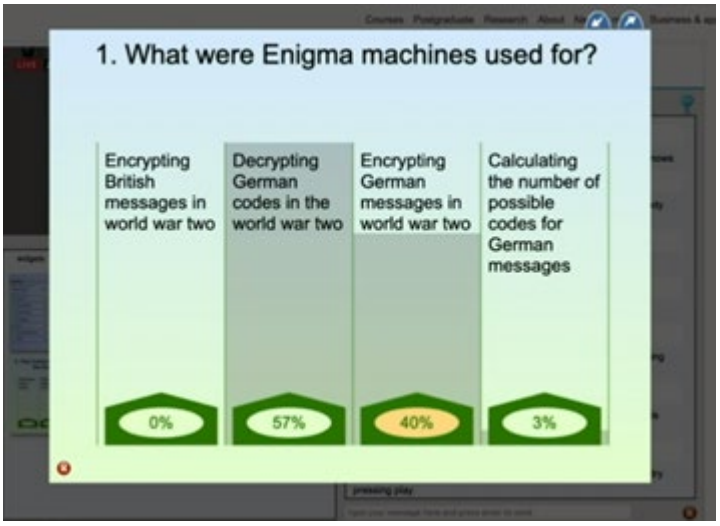

Figure 2 – Example of multiple-choice question widget used during virtual visit to Bletchley Park Musuem

Questions were generally mathematical, as the topic was cryptography. However, the onscreen discussion covered wider areas such as relating to how the Enigma machine was used. Questions grew in complexity as the webcast progressed and there was a good level of interaction from the participants. Onscreen presenters were able to see widget results via an iPad and commented on participant answers, hence enhancing the real-time aspect of the event.

There were several different cameras: one fixed at the Enigma display, one overhead camera and one mobile, to follow presenters as they moved around the displays. The use of different camera angles helped to give online participants a feeling of how it may be to visit the museum in person. For example, Figure 3 shows what happens when different letters are typed into the Enigma machine, highlighting how the various ring settings were set. In the figure, Tom is pressing Y on the keyboard, but E is lighting up, demonstrating the encoding process.

Figure 3 – Overhead view of Enigma machine from the virtual visit to Bletchley Park Musuem

Overall, the webcast was successful. Technically, the webcast proved challenging due to connectivity issues which were not identified during pre-event testing, yet the KMi team worked successfully to resolve these, being familiar with such pressures. The presenters were reassured that backup plans were in place, and limitations were worked around in a professional manner between KMi and Bletchley Park Museum.

Changes

Several necessary changes were required to complete this project. The visit was provisionally scheduled for the week commencing 15th March 2020, as this date immediately followed final assessment of the two largest Level 1 modules TM111 and TM112. Slight delays in preparing for the webcast resulted in a new date of the 20th April 2020 being agreed. The project team felt this was still a good time for the webcast as a new cohort of TM111 and TM112 students started studies around this time. However, strike action at the OU and inability to prepare resulted in postposing the webcast until May, just before Victory in Europe day. It was then necessary to pause the project due to COVID-19 and Bletchley Park Museum being inaccessible.

In August 2020, the project team were informed by Bletchley Park Trust that it would still be possible to deliver a webcast at the museum, although it would need to occur by 1st October 2020 at the latest due to operational changes. Therefore, at short notice, a practice session was planned for September 21st and the live webcast for September 29th. The webcast focus changed from a Level 1 student introductory activity, to become a welcome back event for returning Level 2 C&C students. All Level 2 module students were invited, via email and a message on module sites (M250, M269, T227, TM254, TM255, TM257, TT284).

As a consequence of repeated delays and restricted date options, a decision was made to reduce the complexity of the webcast. The webcast was originally designed to be audience-led and onscreen polls were to be used to decide upon exhibits would be visited. However, rather than run for approximately an hour at several locations on the site, the webcast was refocussed as a live 30-minute Enigma demonstration at a single location, Block B. The event was Covid compliant, with associated Covid risk assessments having been completed prior to the event.

The original plan also outlined BCS OU Student Chapter involvement, to promote the benefits of membership. However, this was not possible due to delays in establishing the OU's BCS Chapter and COVID-19 restrictions.

Findings

The project was evaluated by analysis of participant demographic (e.g. geographical location, index of multiple derivation) and via a student feedback survey (Appendix D).

Participation

A total of 5309 students were invited to take part in the virtual visit through communications posted in Level 2 C&C module forums. It was not possible to send a direct email to all Level 2 C&C students as the OU was limiting non-essential email communication during the COVID-19 pandemic. The virtual visit had a live participation rate of 2% (101 students). The demographics indicated that the student group was representative of the target Level 2 modules: 7% BAME, 20% with a declared disability, 25% female, 30% residing outside England, and 42% identified as being in the lowest 50% of the Index of Multiple

Deprivation. Referring to Figures 4 and 5, most virtual visit participants were aged between 35 and 44 years (48%), whereas most Level 2 C&C students are aged between 25-34 years (48%).

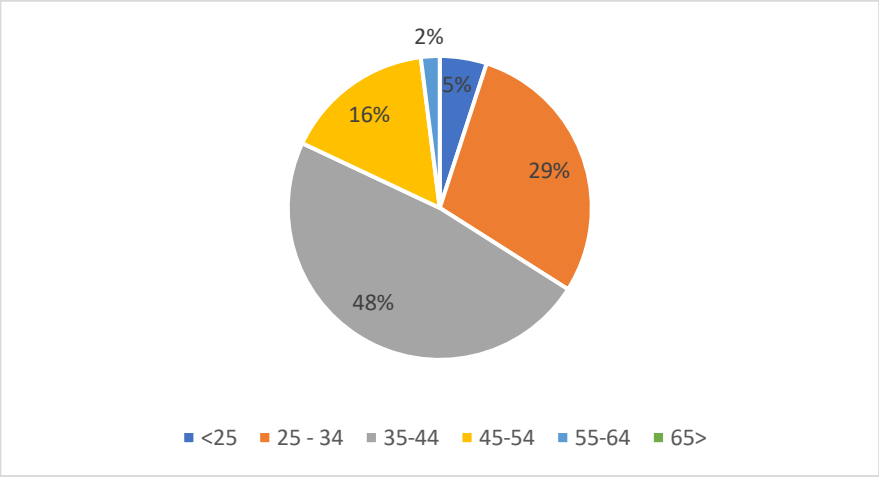

Figure 4 – age bands of Bletchley Park Museum virtual visit participants

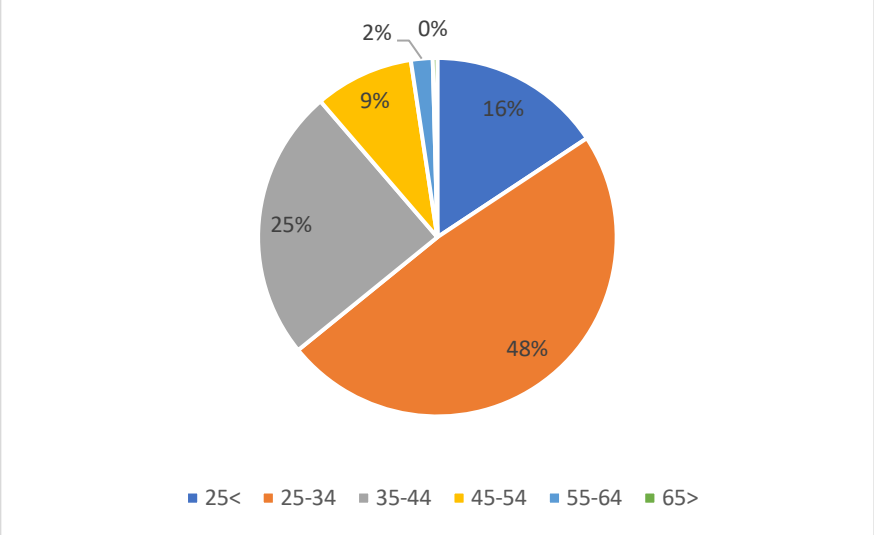

Figure 5 – age bands of Level 2 Open University Computing and Communication students studying in September 2020.

Analysis of residing locations of student participants using Google Maps to estimate travelling time (issues such as road closures, traffic and train delays were removed from estimated travel times) found that 64% resided over 2 hours in traveling time from Bletchley Park. Student survey data produced similar findings as 54% stated they would find it difficult to visit Bletchley Park in person.

Student survey respondents using a 1-5 Likert scale reported that the virtual visit had 'increased their motivation towards OU study' and 'improved their overall OU student experience' 'quite a bit' (4 out of 5 on Likert scale). However, the student survey also found that respondents felt that the virtual visit had only 'somewhat' supported teaching and learning and aided preparation towards their next module (3 out of 5 on Likert scale). 100% of student survey respondents said they would participate in future virtual visits that were relevant to them. 100% of survey respondents also said they now wish to visit Bletchley Park Museum in person.

Student engagement

During the 40-minute event, 414 messages were posted in the chat box, from 133 different participants. Table 1 summarises the different categories and number of messages, given in order of posting:

Table 1: chat box message types and quantities

Message category	Number of messages
Welcome/introduction	71
About myself	49
Technical issue	19
OU curriculum	6
Content rotors	2
Rotors comments	16
Content codes	133
Enigma (unprompted)	20
Enigma responses	6
Encryption (unprompted)	3
Encryption responses	6
WWW2 comment	3
Concluding remarks	61
Social	19

Figure 6 presents the proportions of these chatbox messages categorised into seven areas, demonstrating the extent to which the interaction did focus upon the content of the visit, i.e. the Enigma machine and encryption.

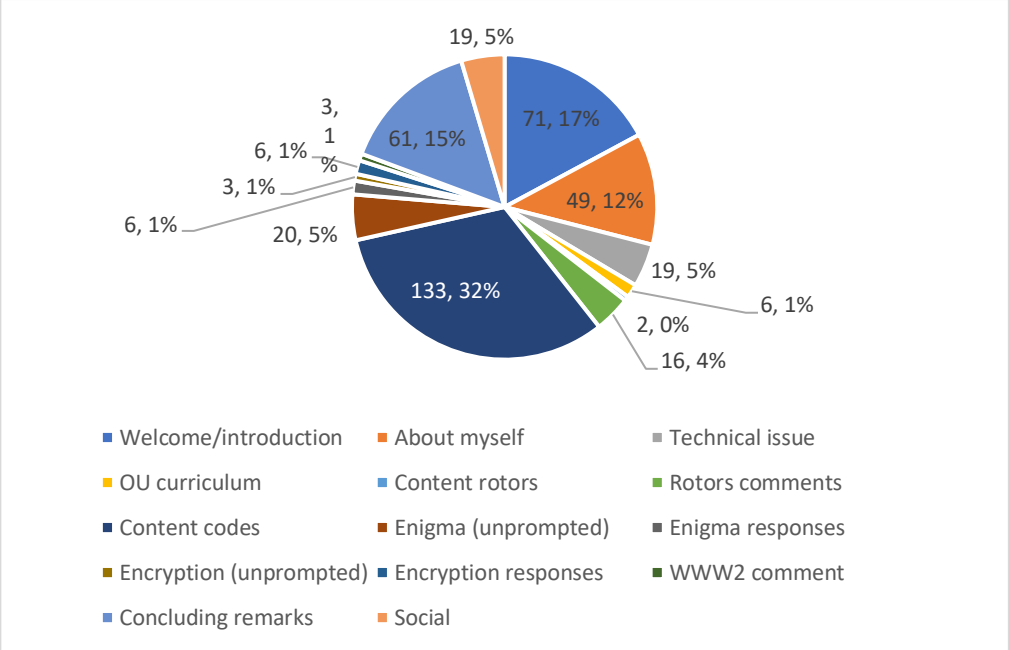

Figure 6 - categories of chatbox messages posted during the virtual visit to Bletchley Park Museum

Unanticipated outcomes

It was notable that a further 63 non-student participants joined the event: we believe these to be Associate Lecturers, regional academics, central academics and Academic-related staff. Evidently interest in the event had a considerably wider range than the original target audience.

Impact

Student experience

One of the main aims of the project was to bring the curriculum to life, via a real-time interactive event. Modules already provide positive learning and teaching experiences, so the interactive visit to Bletchley Park provided a rich supplement to the main module materials. This is demonstrated by the following quotation by one of the survey respondents: "Experience and satisfaction was already high but interactive activities with other students/staff was great."

Student survey data showed that participants enjoyed the visit and that they would like to participate in future events of this kind. There was no conclusive survey evidence to suggest that the visit increased student motivation or the overall OU student experience. However, there were several comments from the survey evidencing that positive impact on student learning, for example:

- "Helped put a physical view on the theory studied. Cryptography"
- "Fired my enthusiasm for the subject."
- "Yes. It was fun and interesting and made me want to study."

A further project aim was to put maths into context of computing, helping students to see why maths is part of the Computing and Communications curriculum. Initially, we reviewed level 1 modules to make direct links from level 1 content to encryption/decryption. As our initial timescales had to be amended in response to Covid-19, we changed the focus of the event to a Level 2 bridging activity. Time limitations meant that there was no opportunity to do the content matching for the Level 2 modules.

It is encouraging to note the positive response to the question 'would you participate in a future visit'. Survey results (100%), alongside chat box and onscreen widget analysis, may indicate that the virtual visits augment teaching and learning and thus positively influence the student experience.

Although most participants would find it difficult to visit Bletchley Park in person, 100% of student survey respondents said they would like to visit the museum. This does not necessarily mean all participants will visit Bletchley Park in future; however, it does show that the virtual visit has either reinforced or increased the participants' motivation to visit the museum in person. Students who subsequently progress to visiting the museum in person may augment their studies through fully experiencing the museum's exhibits and their associated learning.

The project was adjusted as a result of Covid-19 to become a bridging activity and so it builds upon findings from Pawley and Hughes (2018) and Chetwynd et al. (2018).

The project has also demonstrated the potential of virtual visits to contribute to student retention, as they provide an opportunity for collaborative learning, and development of a community of practice (Lave and Wenger, 1998). There is also opportunity for widening participation, with increased accessibility to extra-curricular activities. This in turn could increase student motivation as they progress through their qualification, for example during study breaks between modules.

A recording of the virtual visit is available on the C&C Study Site (2021) in a section entitled 'Discover Bletchley Park'. This means students who were unable to participate live can still gain partial benefits from the virtual visit. The recording has also been shared with Introduction to Computing and IT (TM111) students via its module forum. Students studying the module were appreciative that the recording of the virtual visit had been shared with them. Comments in the module forum included:

- "This was interesting from start to finish"
- "I watched the live webcast, but may well watch it again"
- "I watched this a few days ago and had a go at writing one from scratch" (i.e. own cyphers using an Enigma machine emulator).

It is also planned for a recording of the virtual visit to be included in the module resources and on the apprenticeship websites.

Teaching

At present, effects of the project on various areas of teaching at the OU can only be anticipated. The techniques, possible benefits and organisational issues have been widely shared within the OU, via the following:

- CALRG workshop
- eSTEeM conference in 2020 and 2021
- OU pan-university conference
- Access and Participation Conference
- Employability conference
- OpenTEL conference.

Each of these has had attendance from Associate Lecturers, central and regional academic staff. We anticipate that KMi will have data in due course from interested parties wishing to discuss the incorporation of the technology and the methods in modules from across the OU. We are aware that successful dissemination has not been limited to STEM colleagues: 63 of the total 164 participants were OU members of staff. This suggests there is a real interest among the OU staff community in using interactive webcasts at other off-campus locations to enhance student experience.

External dissemination of project results has been considerable and there is optimism that the OU's innovation in this area will be recognised across a wide area. One particular area to highlight is the AMPS conference (2021). This virtual conference, entitled Online Education – Teaching in a Time of Change, was held in April 2021 as part of the Teaching and Research Initiative of Routledge, AMPS, PARADE in collaboration with the University of Manchester / Manchester Metropolitan University. Our OU work was presented as one of a large number of sessions with presenters from 30 countries, representing over ten discipline areas. Video created for the AMPS conference is available to external academics via the AMPS Academic YouTube Channel (2021).

We believe that findings from this project could influence changes to teaching, learning and assessment design practices across OU faculties. A live interactive webcast is currently being considered for new module TM359 'Systems penetrations testing' which is part of R60 Cyber Security. A live interactive exercise test webcast using new onscreen widgets is being planned for new Health Science module SK190 and Sports, Fitness and Coaching module E236. Arts and Humanities academics are currently considering including a virtual museum visit to its curriculum.

Other areas of impact

Findings from this project have shown impact beyond teaching and learning. This work suggests that museums and other organisations such as employers could use live interactive webcasts as an alternative audience engagement method. Results from the present study imply that virtual visits do not discourage individuals from visiting in person, and in fact may promote real world participation. We believe that live interactive virtual visits could be a useful way for employers to augment and upscale existing site insight visits they organise. Interactive virtual visits could allow employers to reach a broader range of potential candidates which may increase their workforce diversity.

OU Careers and Employability Services held a virtual tour of an employer in April 2019 after becoming aware of this project. Although the virtual tour was a passive experience in that the audience did not interact with onscreen guests in real time, feedback from students who viewed the visit was excellent. The Association of Graduate Careers Services (AGCAS) included an article detailing the virtual visit to Bletchley Park in its August 2021 edition of "Phoenix". AGCAS were interested in how the visit widened participation and could be used to enhance graduate outcomes. This may influence the direction of career service and employability strategies at other universities.

Possible future work

In addition to how interactive webcasts are currently being considered for inclusion in Arts and Humanities, Health Sciences, Cyber Security and Sports, Fitness and Coaching qualifications, there is potential for interactive webcasts to be used for other areas of work at the OU such as student recruitment and the library. For example, OU Wales made some informal enquires as to how the webcast technologies could be used for Welsh specific recruitment activities.
Individuals and research groups not associated with the OU regularly express an interest in the use of live interactive webcasts at conferences and other events. For example, a researcher from India expressed an interest to work in collaboration with the OU to research if interactive webcasts could be used to expose remote pastoral shepherd communities to environments that they typically would not have access to. There is potential for national and international knowledge exchange projects and funding opportunities with other institutions. Furthermore, continued webcast research in collaboration with other organisations could positively contribute to future REF submissions due to findings having worldwide impact.

In June 2021, a workshop was delivered at the eSTEeM conference. The purpose of the workshop was to increase awareness of how interactive webcasts could be used and to investigate ways in which they could be incorporated into other areas of teaching and learning in the future. A list of comments and suggestions of ways interactive webcasts could be used was collected during the workshop and can be found in appendix E.

List of deliverables

- Bletchley Park Virtual Visit recording (2021)
- Discover Bletchley Park page on Computing and Communications Study Site (2021)
- AMPS conference (2021) video (89 views, 13th July 2021)
- APS conference (2021). 6h Biennial International Access and Participation Conference presentation
- eSTEeM (2020). Best poster winner
- Open Research Online

- eSTEeM conference 2021
- AGCAS Phoenix article August 2021

Figures and tables

List of figures:

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University approval processes

- *SRPP/SSPP – Approval from the Student Research Project Panel/Staff Survey Project Panel was obtained according to the Open University's code of practice and procedures before embarking on this project. Application number 2020/069*
- *Ethical review – An ethical review was obtained according to the Open University's code of practice and procedures before embarking on this project. Reference number HREC/3661*

Appendices

Appendix A – running order
Appendix B – student survey questions
Appendix C – comments and future work

Appendix A - Running order

Time	Section	Widget/interaction
7.30	**Introduction (to camera):** Chris to start, introduce BP, introduce self. Tom to introduce self. Chris - Location of BP, location of students Chris - Mention Enigma demo is focus, maths challenges Link maths-computing	Map Filler – tell students that BP is close to OU, encourage visit.
7.35	**Part 1: Setting up Enigma part a (camera/chat mix)** Tom to ask what is Enigma machine Tom to say a little more about Enigma Chris/Tom to review responses	Enigma machine Filler – more about Block B
7.40	**Part 1: Setting up Enigma part b** Tom to explain rotas	How many combinations? Filler – some hints about calc.
7.45	**Part 1: Setting up Enigma part c** Tom - Ring settings Tom - Plug boards	How many ring settings? Filler – how often were settings changed?
7.49	BP video clip	
7.50	**Part 2: Encrypting and Decrypting [part a** Chris to say we're moving on to the next part Tom to look at widget response – big number, put in context Tom to ask for random set of 3 letters Chris to check chat (iPad) Tom explains difficulties of random selection, Chris to comment.	How many combinations in total? Letters to chat box
7.55	**Part 2: Encrypting and Decrypting b** Lampboard demo, Tom to set rotor numbers Chris/Ben to type numbers to chat Tom to show typing in word and which lamps lit	Chat box

	Ben/Chris to input letters to chat Chris to read back letters, Tom types them in, and decodes to 'hello' Tom to note Enigma simulators and URL.	
8.00	**Wrap up (to camera)** Chris to say thanks to Tom and BP Give some links to L1 modules Q&A? Thanks and good luck with studies.	

Appendix B - Student Survey Questions

1. This interactive webcast has supported teaching and learning delivered to me so far as a student.
2. Participating in this interactive webcast has increased my motivation for upcoming study with the OU.
3. This interactive webcast has helped me in my preparation for study of my next module.
4. This interactive webcast has improved my overall experience and satisfaction as an OU student.
5. I find it difficult to visit Bletchley Park Museum due to my current circumstances (e.g. geographical location, cost, parental responsibilities).
6. The interactive webcast has made me want to visit Bletchley Park in future.
7. I would join a future virtual interactive webcast of relevance to me if offered.
8. How could we improve interactive webcasts in future?

Notes

a. Questions 1-4 offered a choice of answers as follows: “not at all”, “very little”, “somewhat”, “quite a bit” and “a lot”. Each of these questions also offered respondents the opportunity to provide additional comments in a free text format.
b. Questions 5-7 offered a choice of answers as follows: “false”, “not sure”, “true” and offered respondents the opportunity to provide additional comments in a free text format.
c. Question 8 was entirely in a free text format.

Appendix C – Comments and Future Work

Would be good to expand this technology to work with level 1 modules e.g. SS011 day schools (rather than using Adobe Connect)
How can other senses be addressed, e.g. sense of smell?
What are the relative virtues of different venues, e.g. fixed location versus outside broadcast – interactions, risks (especially with large groups)?
Be careful not to make assumptions that students *want* to meet us!
Where there is opportunity for external engagement, particularly when distance is an object
Visits to venues that only provide screens tend to disappoint – people want to *experience* things, not just watch.
Hold virtual visits to other places such as engineering visits (Mclaren, Red Bull)
Include in environmental management pathways, to show progression into careers
Health science – use with clients such as asking health screening questions where there are clear PBL-type questions
Musicians – music to music interaction, for example of the following types: “would you like the cellos to play at this point?” or the virtual conductor advising “play louder”